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# The Geographical Journal

Vol. LXI No. 6 June 1923


## PRESENT CONDITIONS IN INNER MONGOLIA


L. H. Dudley Buxton (Albert Kahn Travelling Fellow 1921)



*Read at the Meeting of the Society, 23 April 1923.*


THE country described in this paper is known to the Chinese as the Country of Long Grass: it lies just beyond the Wall on the great trade route from Kalgan to Urga. Although the road and the immediate neighbourhood of the road are very well known and have been described by many writers, it was my good fortune to ride through a small part of the land at a particularly interesting time. When I left Peking Wu Pei Fu and Chang Tsao Lin had just started to fight, and as I came down the pass leading to Kalgan on my return, I met scattered bands who had decided after the manner of Chinese soldiery that for the time being, at least, they were better employed as civilians.

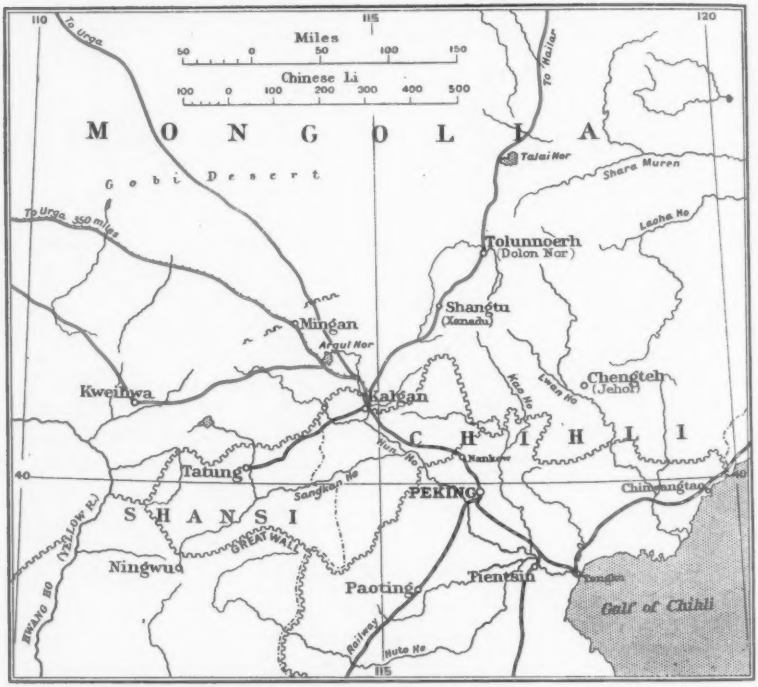
Once the traveller has passed the Wall which for so long separated the Middle Kingdom from the northern barbarians, he finds himself in a land of whose existence he may have had the vaguest knowledge but with the stories about which he has probably been acquainted almost from childhood. Away to the west is the kingdom of Prester John, to the east only a few miles from the road is the old city of Shangtu where

> In Xanadu did Kubla Khan
> A stately pleasure dome decree;
> Where Alph, the sacred river, ran,
> Through caverns measureless to man,
> Down to a sunless sea.

The present journey was made with Dr. Stevenson of the Union Medical College in Peking, which we left on 29 April 1922. We travelled along the main road from Kalgan for about 220 li, a nominal 75 miles, though distances to a mile or two do not matter in Mongolia. We then left the road and turned westwards till we came to the Swedish mission station at Hallong Osso, where the missionaries were good enough not only to allow us to use the mission as our headquarters but also to set their knowledge of the country and the language at our disposal.*


* I should like to take this opportunity of thanking both the Swedish Mongolian Mission and the Kalgan Branch of the B.A.T. for their hospitality and the Peking Union Medical College for supplying drugs.

The road by which we travelled is the old trade route into North Central Asia from Peking. Now that the railhead has been carried as far as Tatung, the position of the border mart of Kalgan has been seriously affected, although it has benefited by becoming the starting-point for the Urga caravans, which in the old days started from Peking itself. The political situation has made the railhead less effective because, during last summer at least, the railway was so uncertain in its running that many goods were carried down on camels right to Peking, as in the old days. There was also a big accumulation of goods waiting for the




Sketch-map of Northern China and Mongolia.

railway to resume operations. The great trade route of Inner Mongolia was quite disorganized, a temporary thing that may have long lasting results, as in its own way the old camel and cart caravan road is just as sensitive an organism and as liable to be dislocated in action as a railway. I had hoped to have travelled along the more rugged route leading by Jehol to the old imperial hunting-grounds; unfortunately this road was too disturbed to be practicable.

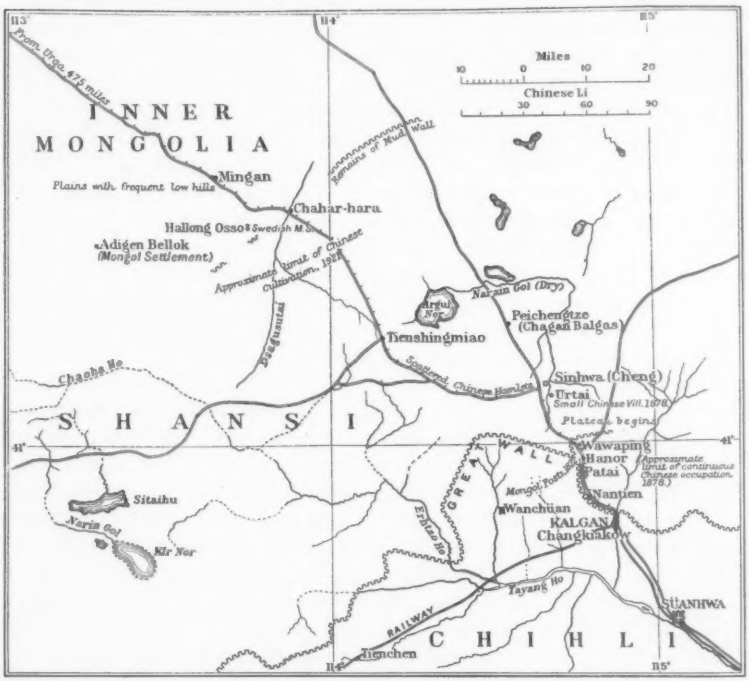
When we rode through the north gate of Kalgan we were starting on the most travelled route in Inner Mongolia, on one which more than

any other has been and still is open to outside influences. Along this road the foreign merchant, the Chinese trader, and the Russian ride, taking their goods by camel, by cart, and by car or lorry. The petrol-driven vehicle is playing the same part that the ships of the merchant adventurers to the East played in the old days. The car does not always get through, but when it does it brings high profits to the owner.

The road out of Kalgan runs along a stream-bed full of boulders and bordered by brown hills, with a thick covering of loess. There are little adobe villages built at intervals usually on both sides of the valley; sometimes the people live in caves in the loess. Travellers go on camel, donkey, or horse, some ride in carts, many go afoot. Most of the wayfarers are Chinese, but there are usually a few Mongol camel-drivers. The first stopping-place is Patai, about 40 li from Kalgan at the foot of the escarpment. The trail thence is a difficult one; it leads past a little Buddhist temple up to the village of Hanor, beyond which the climb is very severe. There is a narrow track worn in the rock, so narrow that in places two carts cannot pass. A bit of the Wall runs along the crest, the road going through it at the village of Wawaping. The watch towers are still in fair condition, though the Wall itself is altogether ruined. The escarpment is very steep on its southern face and forms not only an historical but a marked climatic boundary. The loess extends only a short distance beyond the village of Hanor; after that the road is rocky, and such loose soil as there is consists of blown sand which accumulates against house walls or other obstruction after a high wind.

The contrast between the landscape on either side of the divide is very marked. To the south there is broken range after range, little terraced valleys, the great cleft in the hills in which Kalgan stands, and in the distance the summits of the northern outliers of the Western Hills. The predominant colour especially at this time of the year was a series of browns and yellows. To the north of the escarpment the hills are green and slope down gradually; in a north-easterly direction the mountains are high; elsewhere the traveller sees nothing but rolling hills which gradually become plain. The villages, too, are different from the ordinary type of northern Chihli. The city of Sinhwa (Ch'eng) is 90 li from Kalgan. It is considered a day's journey. The old mounds which cover the ruins of the walls are most impressive; it is possible to trace the course of the walls and to see where the gates once stood. We had no time to explore the city properly in daylight, but the area originally covered must have been a large one, and the ruins there were the largest that we saw. The modern town, although also the largest we met with, does not nearly occupy the old city boundaries. I am inclined to think that this must be the Chagan Nor of Marco Polo, although the present lakes are some distance to the north. Marco says that this city is three days' journey from Sindachu. The distance between Suanhwa and Sinhwa is about 55 miles, just about three days' camel journey as the

road is a bad one. Peichengtze, which is identified by Yule as being the old Chagan Nor, is nearly a day's journey to the north, which would make four not three days' journey. It is, moreover, unlikely that at any time there were two large cities so close to one another, nor as far as I am aware are there any considerable ruins in the neighbourhood except at Sinhwa. Timkowski refers to Chaghan Balghas, which he says is 30 miles north of the Wall. Unfortunately I do not know the Mongol name of Sinhwa. There is still a river in the neighbourhood, but at present the lakes, of which there are many, are at least two days'




**Sketch-map of Inner Mongolia.**

journey north. There are traces of a rampart about 90 miles north of the Wall near Argul Nor. This identification would make the three days' journey from Suanhwa and Chagan Nor, and between the latter town and Lama Miao about the same distance; but 120 li a day is hard travelling for any one but a Mongol. It seems more likely, then, that Sinhwa is the old city Marco called Chagan Nor. Piassetski says that there is a Chinese inn at Bourgasoutai or Bourgol stai (he gives both spellings), but he makes no mention of ruins. The general impression derived from the various travellers is, that with the exception of one

1. CARAVAN PASSING PATAI

2. PATAI

3. A CAMEL CARAVAN

4. LOOKING SOUTH AT THE KALGAN PASS

5. LOOKING SOUTH FROM NEAR HANOR

or two they were so glad to come to the end of their journey that the details of the last day's march were of little moment to them. They seem, however, generally agreed that there are ruins at Bourgasoutai and that it is the last station on the road before reaching the pass.

The next day's journey to the north leads over rolling plains with hardly any undulations, comparatively well cultivated and populated; there are several Chinese villages along the road, and all had every outward sign of prosperity. A few Mongol encampments are to be found from time to time, mostly of a temporary nature, caravans going along the road. Rugged mountains can be seen to the north. The country begins to be less cultivated about 40 miles north of Sinhwa, and by the time Chahar-hara is reached cultivation ceases altogether. This place is the first permanent Mongol settlement on the road; the Amban has a Chinese house, but there are no Chinese resident there.

We turned off the road at this point and explored the country to the south. The road to Kweihwa ch'eng (Map 1) seems to represent the boundary at present between the Chinese cultivation and the Mongol pastures. In this direction the country is made up of rolling downs rather than great plains; there are stream-beds in the valleys, and in places after the heavy rain the water was lying, but there was no water in the streams. The bottoms of the valleys are usually occupied by tracks. The villages and settlements usually lie off the tracks; that is to say, in a little hollow in the hills, usually a small subsidiary valley. The apparent lack of connection between the tracks and most of these little Chinese villages is curious and striking. The hills are all rounded and, though there are stony patches, rock outcrops are comparatively rare and the soil is generally light and sandy. Wild life is very abundant. There are herons in the occasional pools, but by far the most abundant birds are a kind of lark which fill the air in the early morning with their song.

To the north the country is very different. Cultivation and the Chinese agriculturalist have not yet reached it. The landscape is made up of grassy plains, valleys, and downs, but in many places the stony outcrops are more frequent and the hills often have more character. There are a few track ways, but these are absent except along the alternative caravan routes—alternative, that is to say, to the main road which follows the telegraph. The villages are all Mongol; usually they seemed to contain about ten yurts. In some of the valleys they pasture the herds of ponies. Thirty miles or so from Hallong Osso the Mongols showed us a valley which was justly famous; it contained eight bushes, of a species allied to *Ulmus montana*. I think that the best comment on the vegetation of this country is that we should ride many miles out of our road to see eight shrubs.

Chinese trade goods are penetrating into these remote valleys. The Amban who entertained us to breakfast spoke excellent Chinese, had a

son who wore Chinese uniform, and produced a tin of cocoa, which he said he thought foreigners liked; he smoked green Chinese tobacco out of a Chinese pipe. His village was further decorated by little windmills made out of old tins; the noise they made served, we were informed, to scare away the wolves. I did not, however, see any Chinese except with a camel caravan beyond the first valley north of the western road. This point may be safely taken, at least in this area, as the limit of expansion in 1922.

The descriptions of the main road from Russia to China are very interesting, showing as they do the changes that have taken place along the road. We have shown that there is reason to believe that it is Marco Polo's road. Timkowski in 1822 passed by the same way and, I should gather from his description in one place, by the very same track. One short passage of his is almost word for word what I wrote in my own notes; in other places it is surprisingly different. He mentions the "station" of Tsagan Obo, which I believe corresponds to what the Chinese now call Chahar-hara. He says that a rich "tsakhar" lives 100 paces from the station—one still does; I drank tea with him, but now he lives in a Chinese house I have already mentioned. There are now no longer any Mongol posts at the top of the pass, and the first Chinese village is no longer "Nortien." There can be little doubt that Timkowski means by this the village of Nantien—*i.e.* south side—a village which lies but a little way outside the wall and whose position can be seen on the sketch-map. The extent of Chinese influence in this direction in the reign of Tao Kuang a hundred years ago is of great interest. Timkowski expressly states that this village was 20 versts (about 15 miles) from Kalgan. It is probable therefore that he has misapplied the name, as Nantien, a common Chinese name, is nearer Kalgan, and from his description and map it seems more probable that the place he means is what my driver called Patai, the rest station at the foot of the pass.

When Piassetski travelled by the same road in 1875 this village was still the first Chinese village, and it would appear the first place on the road where the traveller heard the Chinese language spoken. North of this point he saw no cultivation except potatoes, although he remarks on the cultivation in the valleys south of the pass; at this time there were certain small Chinese houses on the road even as far north as Mingan.

I have unfortunately not been able to find an English translation of Pozdrieyeff, who travelled, as far as I can understand, by the same road in 1892 or 1893.

These travellers all came from the north. There is a further traveller who, coming from the south and speaking Chinese and knowing the history of the border, is of especial interest for our present purpose.

Dr. Bushell travelled by almost the same route in 1872, and he has left a very interesting account of his journey which was published in the

*Geographical Journal* for 1874. In the last fifty years profound political changes have taken place which have in many ways altered the country. China has become a republic; the Manchu banner men no longer guard the border; Russia and all that Russian rule promised for Mongolia has for the moment come to nothing; even on the banks of Chagan Nor and through all the border there is dim talk of the fighting up at Urga 600 miles away. Most important of all is the steady pressure of the Shansi cultivators.

Dr. Bushell describes the ancient city of Sinhwa as being completely deserted and overgrown with grass. Last year it was a most flourishing Chinese trading outpost in spite of the trouble on the border: it has two quite large inns and forms the end of the first stage from Kalgan for those who travel in carts. The distance is 90 li; the camels do a rather shorter stage of 60 li. The whole place was so full when we arrived that we were compelled to sleep in the shop of a friendly trader. The majority of the people seem to be Moslems; there is a mosque, and one of the ahuns professed to be able to talk Arabic—he could not be found when we offered to test his knowledge. There are still large empty spaces inside the walls, but at present there seems every indication that the city will regain the greatness it enjoyed in the Liao dynasty. Chinese traders are quite a prominent feature of the road in this district, both those who dealt wholesale and were engaged in trade between Urga and China, and the small hucksters who sold things to eat and, so they said, cheated the Mongols. Owing to the disturbed state of the country there was not a great deal of traffic, and some of the Chinese drivers who had come down from the north said it was too dangerous to go back again, but we met several caravans who were going to or coming from Urga. These usually included Chinese traders and Mongol camel-men; one which came along with us some of the way was very impressive, as it was headed by a large two-wheeled camel-cart. The carts we met on the road were usually driven by Chinese.

In advance of the traders the agriculturalists are slowly eating up the prairie. Dr. Bushell writes: "There are some settlements of immigrant Chinese on the border of the plateau, as well as about the stations of the north-east trade routes, but they earn with difficulty a miserable subsistence by the cultivation of oats, rape, and potatoes, which have barely time to come to maturity during the short-lived summer. There is small prospect of encroachment in this quarter; further east, where the country is hilly and the valleys fertile, as well as in Manchuria, the Chinese agricultural settlers are numbered by the million, and the aborigines are being either pushed to the north or compelled themselves to become agriculturalists."

To-day the Chinese farmer has pushed far beyond the bare stony ground at the top of the pass. Last summer they broke up for the first time 3 li forward towards Gobi. There are many intervening tracts

not cultivated, but they have now advanced on a very large front to a distance of about 70 miles from Kalgan. Last year I know they ploughed a mile forward, which almost exactly coincides with the yearly average. The beginning of the ascent is about 15 miles from Kalgan, and in 1872 they were cultivating the border of the plateau, a point about 3 miles from the bottom of the pass: in fifty years they have therefore advanced about 50 miles. I have no means of estimating whether this progress has been carried on elsewhere, nor the length of front on which these sturdy farmers are advancing.

The increasing number of these Moslems on the border is a matter of great importance, both because the Moslems in China have not yet been properly studied and also because the Moslems have in the past proved to be some of the most turbulent of the Chinese. The Moslems are usually known as Hui hui, although in Peking they are often called by the less polite form of Hui tzu. There are several groups present in China whose origin is different. First, in Peking, in the south-west corner of the Chinese city, a flourishing community of Arab Moslems live. Once they discovered that I could read a little Arabic they were very friendly, and apart from Broomhall's book most of my information about the Chinese Moslems was gathered from them. They form an entirely different community from the people in Inner Mongolia. The ahuns (teachers) at any rate all speak Arabic, all cut the moustache, abstain from pork and tobacco, and are physically very different from the Pekingese. They used before the war occasionally to send some one to Stamboul to learn the proper way to read the Koran. They claimed to have come to Peking by sea by way of Canton. The Turki community in Peking who claimed to come from Samarkand spoke Turki but not Arabic; they observe the pork taboo but smoke tobacco, an unusual thing for the Moslem in China. Both these communities claimed to have no connection with the Moslems in Sinhwa. Unfortunately I did not get an opportunity of talking to any of the ahuns there. In the latter place they claim to be akin to the Shansi and Khansu Moslems; indeed, most of the immigrants are from the former province. They do not eat pork nor smoke tobacco, but they have no objection to others smoking. My Moslem hosts were the agents of the British American Tobacco Company, and always offered us cigarettes though they would not touch them themselves. There were quotations from the Koran written above the door of the restaurant, but my hosts could not read them. The Chinese authorities treat these people with great caution, they are not " weigwa jen " (foreigners), but on the other hand not fully Chinese. They have at times shown great outbursts of fanaticism, which makes for the respect with which they are treated.

These facts being so, it is to a certain extent doubtful whether we are quite justified in referring to these settlers who are pressing forward over the plains as Chinese. In spite of the time that they have been

associated with the Middle Kingdom they have not been absorbed, but we have consistently used the term for want of a better, and also because, although the Moslems can often be distinguished by their physique, their general culture is essentially Chinese. It seems probable that these Shansi cultivators pressing forward over the plains are physically akin to the Mongols, being probably of Turki or even sometimes of Mongol affinities although with at least 50 per cent. Chinese blood. For our present purpose, however, we are interested in their culture, not their physique. The culture is, as we have endeavoured to show, materially Chinese, although the religious gap between them and the Chinese is so great. If the future of the border is to be bound up with these people who in the last century have shown themselves such unruly subjects of the Chinese rule, the next generation may have very interesting developments. At present the settlers are too much engaged in their struggle with their environment to have any leisure for politics. If the land they are ploughing shows itself to be sufficiently fertile for their numbers to increase, they will be in a position to follow the example of their co-religionists and possibly their close relations from Khansu. At present all we can record is a successful fight, both against nature and against the Mongols, of a comparatively small body of men who are every day increasing, and who both by their ethnic affinities and by their religious habits are particularly well suited to overcome their geographical environment.

In Peking itself the Moslem trader is at a great disadvantage compared with the non-Moslem owing to the universal part which the pig takes in the food of the people. In the border and in those places where Moslems are numerous this disadvantage does not hold. In Sinhwa, for instance, the principal restaurant is Moslem. Emphasis must be laid on this point owing to the great Chinese habit of transacting business in restaurants.

The Shansi men are, then, advancing into the wilderness with two objects: first as cultivators breaking up the prairie, and secondly as traders. The second carries them further and over wider fields; the first gives their occupation a more permanent nature, and has a greater effect on the country itself. Little villages of adobe are springing up, taking the place of the Mongol yurts; rather dull little villages toning down a whitey-brown and almost invisible except close at hand. In many cases they are admirably suited for defence, being almost walled towns in miniature, not unlike some of the old farmhouses of Europe. Where a village lies on the road there is frequently an inn, where the Chinese travellers stay; the Mongols usually prefer to remain outside. Two types of habitations seem to be springing up: first the walled inn, and secondly what may be described as the walled hamlet. In the remoter valleys the villages are entirely open and trust to their dogs, as the Mongols do, for defence.

The life of these immigrants is no doubt a hard one, but it seemed to us not so hard as in many other parts of China. While on the road we lived on the country, and the diet seemed more ample and varied than I experienced down in the mountains near Foochow, where I tried the same experiment later in the summer. They seemed to have plenty of eggs, meat, and potatoes, and sufficient grain, though at least in the early summer they had no green vegetables. Sharks and cuttle and other delicacies of the south were absent. The sentiment of the Chinese people still regards these colonists as dwellers in a strange land beyond the pale of civilization, and for the most part this feeling is shared by the colonists as far as can be judged; if possible, their bodies are carried within the Wall for burial. Last summer when the defeated Chang retired beyond the Wall public sentiment prevented the victorious Wu from following up his victory.

Such observations as we could make, however, convinced us that by a process of gradual advance the farmers were converting the borderland into part of China. How far the process can be continued is difficult to say. Indications suggest that the drier and sterile areas of Gobi alone will stem their advance.

Our purpose in visiting the Grass Lands, however, was not to study the Chinese immigrants but rather if possible to see something of the Mongols themselves. To all those of us whose fortune it has been to gallop with these wild horsemen across the plains, to sit round an argul fire in their felt tents, and to watch the lambs being folded in the evening, these people have a fascination the greatest proof of which is that we want to go back there again. The break-up of the Manchu dynasty and the opening up of Mongolia has, it would appear, robbed them of their last pretence of freedom; yet last summer there were indications that the people that once terrorized Europe were not so entirely debased as some writers would have us believe.

A number of Mongols are always to be met with on the road in charge of the caravans. We saw a few of their dark blue travelling tents near the road soon after leaving Sinhwa, but did not meet a more permanent settlement till we came to Chahar-hara. At present this is the first big truly Mongol settlement: there is a Chinese house where the Amban lived, a number of yurts, and usually a number of travelling tents. We turned south-west at this point and left the road, and it was in this neighbourhood that we found the Chinese breaking up the prairie. From here onwards we seemed to be in a land that was still Mongol and not yet Chinese.

Summer was just beginning. It usually froze hard at night, and a sheepskin was a comfort if not a necessity during the day. The grass was still low like our downs in winter; spring flowers were appearing everywhere, an ascabius prominent because of its height, a little pink primula in sheltered valleys; most prominent of all was a tiny iris, blue

and practically stalkless, which could be found almost anywhere. In the daytime these great plains have an aspect of monotony because of their lack of prominent features, but at dawn, especially the hard clear dawns of early summer, all the sense of monotony vanishes. The ground is frozen, there is a little hoar frost on the grass; the larks are towering up into the sky; the landscape acquires a form which it has at no other time. Hills, which at noon are only a part of immensity, are thrown into high relief by the great rolling shadows cast by the sun, for on these clear days the sun casts a shadow as soon as it gets over the horizon. These shadow contrasts take away the sameness of form and colour which is so characteristic of the great grass lands and give them an infinite variety of feature which soon fades as the sun mounts.

As you ride across the grass at dawn, the feeling of negation that the plains suggest at noon is quite absent. In its stead the traveller has before his eyes a landscape which is clear in every detail: the tiny shadows of the flowers on the grass, the defined outlines of the distant ponies, the Mongol camp close at hand, all have their place; each fits into the proper part of the picture. Look, and the shadows gradually disappear and out of a hollow in the hills a caravan of camels comes lumbering, drifting past, the leader with his high Mongol hat, huge boots, and probably the red robe of a lama. The camels slouch past with their unwieldy loads, hides and furs and heaven knows what from Central Asia, drifting along the trade route through the Wall to the railway. In return they bring back civilization, tea and silk from China, cigarettes, matches and store goods from Virginia or Pittsburgh.

The caravans pass and disappear between the hills, and the only human things are the little villages of the Mongols. These latter, at least at the time we were there, were nearly always planted on the slope of a hill, usually facing the south; they numbered anything from a dozen to about thirty yurts. In one or two cases we saw two villages within a mile of each other where the water and pasture during the winter was good. Although in some parts of Mongolia the Mongols themselves practise agriculture, we did not see any Mongol cultivation. The best herds of ponies were also away at other pastures. They had flocks of sheep in plenty, which they corralled at night because of wolves. The details of their life have been so often described that it is unnecessary for me to give further details. There are certain differences between the border and the rest of Mongolia in methods of government which are of interest. The administration is carried on by officials who are not autocratic like the Mongol princes but democratic after the Chinese fashion. Some of them, Mongol though they are, wear Chinese dress. Some served in the Chinese army during the war of the summer, although they found it convenient to become Mongols again at an early opportunity.

Every traveller in Inner Mongolia is interested in the question of the inferior racial position of the Mongols and their so-called deca-

dence. I am inclined to doubt whether the Mongols are really decadent, although, to use an old phrase, it is permissible for even so humble a dog as myself to bark without their leave. In order to understand their position it is necessary to consider one or two historical facts. Compared with China the history of the Mongols is a short one, yet owing to the close correlation which it appears to have with environment and climatic conditions it seems to be of special interest. The grass lands of Inner Mongolia, now apparently so typically Mongol, have been subject to a curious to-and-fro movement of people which is due partly no doubt to political changes, but which seems still more likely to have been the effect of deeper geographical causes. Under these circumstances the point of interest to us is not so much the actual Mongols as a people, as the nomadic tribes who at various times have inhabited Inner Mongolia. The struggle to my mind almost resolves itself into a study of the position of the boundary between that agricultural civilization, proudly called by the Chinese the Middle Kingdom, and the barbarian pastoral nomads, to describe whom the Chinese expended all the vituperation of their not inextensive vocabulary. In China and generally among all agricultural peoples, the problem of over-population is met by making the rice-bowl that holds enough for one man only suffice for his wife and her infant as well. The rice-bowl itself is incapable of expansion, but by more labour more rice may be extracted from the ricefields. In the process of such extraction man rises superior to his environment and begins to alter the face of the Earth. The Chinese at a remote period became acquainted with the value of banks which served to fill their irrigation channels and also to turn off flood-water from the cultivated fields. All this they learned in their endeavours to make the rice-bowl feed more than it reasonably could. There came a time however when the rice-bowl was seriously threatened by invaders from the north. The Chinese genius which delights in precedent applied the same method to barbarians which had previously been applied to flood-waters and built the Wall, making, with assistance of the geography of Central Asia, an irrigation channel which overwhelmed the Roman Empire. We are concerned with a little eddy of those flood waters.

If you travel up the Gorge of the Singing Harp to the Bridge of the Bright Dragon—I have ventured to do into English the Chinese names —and see the Wall, and then cross the Wall again on the road I have been describing, you will see again and again the Chinese genius for altering the landscape. The Mongol does not alter it; he at times removes the Chinese and lets Nature regain as much of her lost territory as she can. Usually, though not always, the action of flood-waters is more spectacular than the construction of dams. When the waters have passed, however, the broken dams are an interesting spectacle.

Ellsworth Huntington has correlated the great movements of Asia with changing climatic conditions. There can be very little doubt that

6. CHAHAR-HARA

7. CHINESE DRIVERS, INNER MONGOLIA

8. MONGOL AND CHINESE HUTS, CHAHAR-HARA

9. A MONGOL WOMAN

10. A MONGOL MAN

the Wall corresponds to a great geographical boundary not only in the sense that it is difficult to pass, but also because the climate of Inner Mongolia differs profoundly from that of the region within the Wall. Rainfall or other climatic advantages in the past have in recent times made the northerners sufficiently numerous to enable them to send a surplus population into the fertile lands of China. We have already referred to the city of Sinhwa, now two days' journey south of the Chinese farmers' fields but one day's journey north of the Wall. Although the dynasty which built it was not originally Chinese, the fact that we have so famous a city without the Wall suggests a settled population. The accounts of Marco Polo mention agriculture in the province of Tenduc, that is, probably, in the fertile region round Kweiwa, but although we have no direct evidence of tillage and Marco's statement about the Khan's mares suggests a condition of affairs not very different from to-day, there are sufficient relics of cities of that period to warrant a belief that the country was at least to a certain extent settled. At the beginning of the Ming dynasty the Mongols were confined north of a palisade on the southern edge of Gobi; the Wall in other words may be said to have moved forwards many miles. When the Ming rule became weaker the Mongols began to drift south again, and Howarth has shown that they had already settled largely as far south as the Ordus country in the latter part of the fifteenth century. During Manchu rule Chinese were debarred from the country we are discussing, and there were garrisons of bannermen on the border.

The history of the last thousand years, then, suggests a flow of different peoples forwards and backwards along the line between the Wall and the great desert of Gobi. At present, as we have shown, the Mongols are retreating to the north. How far are geographical causes contributing to this curious and almost regular ebb and flow? Or alternatively, are the reasons to be sought in purely political and religious spheres and not in environment?

At the moment—and it is only with present conditions that this paper is concerned—such evidence as I could gather suggested that in Inner Mongolia active desiccation is in progress. The wells are definitely lower than they used to be. On that point my informants were quite clear. I was shown a well which within living memory had been full up to the top but which now was quite low. Some of the wells are still as full as they can be, but the general feeling is that the plains are drier. In matters of water the nomad tends to be more sensitive than the agriculturalist: the former must have water in large quantities; if he has not got it he goes and looks for it. Unless conditions are extremely hard, the agriculturalist seems to be able to survive. May I make a comparison from a far distant corner? In the great desert of Arizona the Hopi and Navajo live side by side. The water supply is bad; here again we have reason to believe that a gradual desiccation is taking place. The Hopi

are agriculturalists; the Navajo are pastoral nomads depending for the most part on their sheep for existence. The hunting-grounds of the latter are being curtailed and the land is getting drier. As a result the Navajo are either dying out or are taking to agriculture, whereas the Hopi, although decreasing under the influence of civilization, are in spite of adverse conditions comparatively well-to-do. It must be admitted that the agriculturalist as well as the nomad both alike prefer good conditions, but the former is better able to put up with bad, as he can to a certain extent change the face of the Earth while the latter is best able to take advantage of good ones. A natural increase in mankind follows an increase in the flocks. Wealth to a nomad is meaningless and of no practical value. The more sheep you have, the more babies you want to look after them, and where the mares give more milk the odds are in favour of the women doing likewise. But a settled agriculturalist is in a different case. He can and does accumulate wealth and too many children are a disadvantage; they mean division of an already exiguous estate.

Huntington has shown that the periods of great increase in the nomads of Asia and their inroads into their neighbours' territories coincide with periods of great rainfall. I am inclined to think that the present retreat of the Mongols, a very recent phenomenon as I have shown, is due to a similar climatic change; there are, however, other factors which must be taken into consideration.

In reviewing the history of any small part of the world we cannot help perceiving that although we may trace many of the events to environmental causes yet the effects last long after the causes have ceased to operate, especially where a small country is controlled directly or indirectly by a large one. Inner Mongolia from its close neighbourhood to China has been subject to the political effects of that country long after the original causes have ceased to be effective. Thus in recent history the prohibitions of the Manchus which prevented the Chinese from settling in the region beyond the Wall in all probability delayed the advance which is so striking a feature at present. We know, however, that such prohibitions are apt to be disregarded; in the past the Mongols disregarded the prohibitions of the Mings, and to a lesser degree the Chinese disregarded the prohibitions of the Manchus.

The great mobility of the nomads and the stability of the tillers of the earth especially in war is a factor which must not be overlooked. Throughout the history of Mongolia the Chinese may be said to have been always on the defensive. Even to-day such fortifications as there are are limited to the adobe walls of the Chinese inns or hamlets; the Mongols only have protection for their flocks against wolves. The aggressors at present are, admittedly, more likely to be brigands than Mongols, but the old habit or necessity which built the thousand walled cities of China still persists as they migrate to the land of the northern

barbarians. The Mongol, even though there may be rumours of brigands on the road, prefers the old-time custom and sleeps outside these protecting walls. I did not see any actual evidence of the effect of the Bolshevist movements in the north or Inner Mongolia. We all knew in a vague way of the actions of Baron von Ungarn—he is a romantic figure likely to capture the fancies of strangers—but of actual facts I found none. It is, after all, a long journey from Urga to the southern edge of Gobi.

The revolution of 1911, which removed the yoke of the Manchus and at the same time their protecting influence, is possibly the most important political fact for Inner Mongolia. The Russian sphere of influence, although at least commercially it extended far to the south, did not have such a permanent effect that its break-up was seriously felt. We heard that further to the north the Mongols were tired of the Russians and longed again for the easy Chinese rule.

The influence of religion is one that has had a great place in writings on Mongolia. Lamaism is entirely dominant, although some of the old shamanist rites still survive in places in south and east Mongolia. There are certain traditional magical forms and ceremonies in which both men and women take part. Sheep and goats are sacrificed, the sacrificial fire being lighted outside the tent; parts of the animal are burnt and parts are eaten. The officiant sits beside the fire singing, and usually works himself up into an hysterical condition and often eventually becomes unconscious. Festivals are held at the obbos, stone altars built on the hilltops, and goats are sacrificed. Sheep are also sacrificed and parts burnt in the fire at the marriage ceremonies. Some of these shamanistic ceremonies appear to have left traces on the Buddhist ceremonies. In spite of these survivals the dominant tone of the land is a form of Lamaism. About two-thirds of the adult male population become lamas and take vows of celibacy. The condition of the lamaseries has been often described and needs no further comment.

Last summer there was a bad epidemic of diphtheria in the region I visited. It occurred very shortly after we left and caused a high mortality. The relationship of such diseases and the religious habits of the people is close. The absence of family life is an obvious point; scarcely less important for the propagation of bacteria and other harmful organisms is the filthy condition of the lamaseries. Although the occurrence of human parasites in the inns and houses along the road could not escape notice, the lamaseries were greater breeding-grounds than any other place which I have yet experienced. Any new bacterial disease, especially one that is carried or spends part of its life-history in human parasites, is particularly liable to affect the people. The matter is at the moment being put to experimental proof by the people themselves, albeit unwittingly. There seems to be reason to believe that the followers of the prophet are increasing in Mongolia. They are the only clean people

there, and their religious habits with the taboos associated therewith and the necessity for an occasional wash should render them less liable to disease. Carruthers has remarked on the contrast between the prosperity of the Kirie and the Mongols, and attributes this to their religion. In Inner Mongolia the Moslems are Chinese, but there can be little doubt that the contrast between Mohammedanism and Lamaism will react to the benefit of the former.

I have not referred except in general terms to the physical characters of the Mongols round Hallong Osso. One of the principal objects of our journey was to secure as many of these as possible, especially with a view to testing the environmental effect of the country on the human frame, but the matter is too technical for our present purpose.

The present condition of the road itself deserves special notice; we have alluded to the type of wayfarer. The road is restricted to a narrow way over stony ground; on the plains it often meanders over a wide area to avoid the pools which form after a storm wherever the ground is soft and worn. Usually the Chinese and the Mongol settlements are separate, and the Chinese influence along the road extends further to the north than in the open country. There are inns about every 20 to 30 li where food but no provender can be bought. There were rumours of brigands at the time we were there, but considering the disturbed state of the country it was perhaps surprising that the road was really perfectly safe; at the time I am inclined to think it was one of the few really safe arterial roads in China. It forms not only a great artery for through traffic but also serves to distribute supplies to the country round. Evidence also suggested that it formed a very ready route for the dispersion of disease.

To summarize, the present condition of Inner Mongolia is a phase of the northern expansion of the Chinese; this expansion has usually been connected with dynastic events which have often echoed throughout the whole of Asia. For earlier periods we have the many ramparts which as yet remain unexplored, but which suggest that at various times there have been walls or fragments of walls at least four days' journey north of the outer Wall. We have also the ramparts of ancient cities. During the Ming dynasty, in the beginning at least a definite Chinese revival, we find the Chinese influence extending as far as the southern boundaries of Gobi. As that dynastic influence grows less we find the Mongols asserting their old rights until under the Manchus Inner Mongolia, from which the Mongols had so long been excluded, becomes typically Mongol. Even when the Manchu dynasty was tottering to its fall there were still the old Mongol guards on the top of the pass. With the fall of the dynasty comes the advance of the Chinese into the land of the tall grass.

How far these movements can be associated with definite geographical causes it is difficult to say. There is sufficient evidence to suggest that

the present movement at least corresponds to a drying up of the pastures. Further research is necessary before we can discuss the problem in relation to the earlier movements.

There remains the great problem as to whether China has definitely passed the Wall or whether this present migration is one of the periodic movements doomed to ultimate failure when the nomads sweep down and the Middle Kingdom reverts to its ancient boundaries. Many writers have described the view from the top of the pass at Kalgan, both because of the beauty of the natural scenery and because of what may be termed the sentimental value of the place. In front are the vast territories which for so many generations have been the home of civilization and of all that China means, if not to the world, at least to a vast proportion of the human race; behind are the lands of the nomads whose ethnic movements have been felt from Peking to Vienna. On the left there is a deep valley full of green trees; then broken rugged hills, and finally a high sierra against the sky. On the right hand, as the traveller is going into China, there is a ruined bit of the Wall and the square brick watch-towers Timkovski saw a hundred years ago, "three toises square and nine toises high." Distance hides the mountains and dust the plain. Behind those distant mountains lies China.

Before the paper the PRESIDENT said: Our lecturer this evening, Mr. Dudley Buxton, who is lecturer on Anthropology in the Department of Human Anatomy at Oxford, was fortunate enough some little time ago to be nominated for the Albert Kahn Travelling Fellowship, and after you have heard his paper this evening you will probably be prepared to admit that he has taken admirable advantage of the possibilities of study and travel which were thus offered to him. I should like to take this opportunity of placing upon record my appreciation and, if I may say so, the appreciation of this Society of these Travelling Fellowships. They were inaugurated by Mr. Albert Kahn, a French gentleman, in 1911. At that time he endowed four Travelling Scholarships: one for his own country, one for Great Britain, one for the United States of America, and one for Japan. The conditions which he laid down were that the students selected for these Fellowships should travel for a period of one year in certain countries, which were specified, covering a large part of the world, notably India, Ceylon, Java, China, Japan, the United States of America, and the principal countries of Europe. He did not lay down that the holder of the Fellowship should undertake any particular form of research, but he required of him that he should make a general study of the political, religious, social, and economic conditions of the people of the countries visited, and in particular that he should endeavour, so far as possible, to enter into the inner life of the people amongst whom he travelled. Since the war the number of these Fellowships has been reduced, and I understand that at the present time the Fellowship awarded to this country is the only one which is in existence. It must be obvious, I think, that the student who is successful in obtaining such a Fellowship has provided for him great opportunities of studying the people and the countries of different parts of the world, and, as I say, our lecturer this evening is one of the few students who have so far been fortunate enough to enjoy one of these Fellowships.

The particular country which he is to describe to us to-night is one which

he took in the course of his tour, Mongolia, and he will have much to tell us about that country and its peoples. In particular, he will put forward, I understand, an interesting theory to account, in part, for the curious ebb and flow of humanity which is known to have taken place for many hundreds of years past over that stretch of country which lies between the Great Wall of China and the Gobi Desert, the Chinese agriculturist and trader sometimes pushing his way forward towards the boundaries of the Desert, and then with the swing of the pendulum being pushed back, in his turn, by the pastoral inhabitants of Mongolia. Mr. Buxton will attribute that, I think, largely to geographical conditions, and we shall listen with interest to what he has to say upon that interesting problem. He will also be able to show us pictures which he has taken in the course of his studies in Mongolia, giving us a graphic idea of the people and of the country. I now have much pleasure in asking Mr. Buxton to give us his paper.

*Mr. Buxton then read the paper printed above, and a discussion followed.*

Sir JOHN JORDAN: I lived in Peking for twenty-five years, but I am ashamed to confess that I have never been in Mongolia. The nearest I have been to it is the Great Wall, to which I used each year to make an annual pilgrimage. The Mongols, as a people, are of course very familiar to me, for they used to come to Peking every year, and the Mongol market was quite near the Legation, so that we saw a great many of them living in the tents you have seen on the screen.

Mr. Buxton's theory of the desiccation of the country and the consequent movements of the population seemed to me ingenious, but I am not quite convinced. I think there may be other causes. My own experience is that the Chinese have been moving up there at a yearly increasing rate, and not moving only in that particular part of the country, but all along the frontier of Mongolia. Further east, if I recollect rightly, the Chinese have gone even further up. Some part, in fact, of Mongolia has now been converted into Chinese districts and is ruled by Chinese authority. So I am not sure that it is the mere drying up of the wells which causes the Chinese forward movement; as a matter of fact, the pressure of population has probably a good deal to do with it, and we must remember that the Chinaman, as an economic man, is far superior to the Mongolian. He is moving not only there, but all along the line northward, and is occupying N. Manchuria. I lived there some forty years ago, and at that time the whole Chinese population was not more than three or four million. It is now fifteen million. The Chinese, not only from Shansi but from Shantung and other provinces, are moving up north. I remember the western hills, where I lived every summer, when they were free from all cultivation. Now they are terraced to the very top. I mention these facts to show that probably there may be other reasons for the Chinese forward movement; and I may add that I do not think the Chinese will go back. After all, there are only some two or three million Mongolians, and they are a very lazy and not very reputable race, if I may say so.

All this country, I ought to say, is being brought under influences to which it was a stranger in the past. It is quite different from what it was in Kublai Khan's time. There is the railway of some 200 or 300 miles, and other factors which are rendering all this district of great commercial value to the West. If you read Marco Polo you will see that he says that no use can be made of camel's wool. I have a coat of camel's wool, and sheep's wool that used to lie scattered over these plains is now brought down to Tientsin, the

port of Peking, to be prepared and sent abroad. There is a huge industry at Tientsin, the raw material for which is drawn from Mongolia and the regions bordering on Tibet. From Kalgan up to Urga, a distance of 700 miles, was in my early days a formidable journey. The Russian mails used to take some weeks coming down, and now there are motor-cars doing the journey, so that the Mongols will find the pressure of civilization seriously affecting them.

I was much interested in what the lecturer said about the ecclesiastical position, and the influence of Lamaism in Mongolia. The Chinese have always been very tolerant of foreign religions. Marco Polo, you will remember, tells a story of Kublai Khan and the missionaries. When giving his reasons for not adopting the religion they wanted him to, he said he had studied all four religions and found them equally good, and so on. That has always been part of the Chinese policy. When the Mongols accepted the rule of China after the Manchus came to the throne, the great Emperor K'ang-Hsi saw the necessity of using Lamas as a means of exercising ecclesiastical influence with the Mongols. He brought over people from Tibet and established in Peking a living Buddha. He also established one at Urga, and all around Peking he put up those monasteries which exist to the present day. They were, and are still, very large foundations, and had a great deal of influence upon the Mongols. I may mention that in my own time in China the Dalai Lama came to Peking, and it so happened that the Heir Apparent of Sikkim was there and was staying with me. He went round all the Lamaist temples, examined them, and reported to the Dalai Lama about them. He formed a very bad opinion of the whole system, and said there was only one decent Lamaist foundation, that at the T'ai Shan in Shansi.

Perhaps I might, if it is in keeping with the rules of the Society, say a few words about the political situation, for in the course of my duties I have been far more interested in the political situation in Mongolia than in the geographical. During the Manchu dynasty China ruled or controlled Mongolia through the Lamaist hierarchy, and had always a resident at Urga; there was a great similarity between the situation in Mongolia and in Tibet. All through their history the two things run very close together. Both of them were under a department in Peking called the Li Fanyuan, which we used to call the Colonial Office. It was a small, miserable building in a very bad street, and one often wondered how it managed to control far-distant Tibet, thousands of miles off, without any communication. But the prestige of the great Emperors of China still existed and was a potent influence.

In the last days of the Manchu dynasty China went in for a forward policy both in Tibet and in Mongolia, and dispossessed a good many of the Mongolian tribes. That antagonized Mongolia very much, and when the Empire fell and the Republic was instituted in 1911, the Outer Mongolians declared their independence of China altogether. They threw off the yoke of China, and Tibet did the same at the same time. That state of affairs continued for some time, and then Russia came on the scene and took advantage of the opportunity. We watched the situation in Tibet just as Russia had watched the position in Mongolia, but Russia took a much more active part than we did, and made a treaty with Outer Mongolia independent of China altogether.

I should say here, by way of parenthesis, that China has always had great trouble with her outer dependencies. They have very often been anxious to make treaties, just as our Dominions do, without consulting China at all. Such treaties were made, but in the end China has generally been able to bring them before the other Powers and make a sort of tripartite arrangement.

In this case the Russian treaty with Mongolia was submitted to the Chinese and ratified with considerable modifications, just as our 1904 treaty with Tibet was.

After the Mongols had thrown off the Chinese and the Russians had established themselves there, the Soviet Government came in. China broke off relations with Russia entirely, and tore up all the four or five elaborate treaties that had been made during the five years between 1912 and 1915 between Russia and Mongolia. Outer Mongolia got into the hands of the White Guards, and then of the Reds. But Russia has fallen from her high estate, and Russian people are under Chinese jurisdiction. That is the situation at the moment. Mongolia is really the crucial question which will be a decisive factor in determining the renewal of relations between Russia and and China.

Reverting to the economic situation, I think that there will be, as there ought to have been long ago, a railway made from the Russian frontier to Kalgan. When that 700 miles has been bridged by a railway it will revolutionize the whole situation in Mongolia. Russia made the Chinese Eastern Railway for strategic reasons ; but this is the railway that ought to have been made, because if you get that 700 miles opened up then you bring all Europe in close contact with the whole of China. It will save at least a couple of days in reaching Shanghai and other great trading centres in China.

Colonel OTTER-BARRY: My journey through Inner Mongotia in 1911 was hurried. I walked most of the way from Kalgan across Inner Mongolia and Outer Mongolia to Urga, more or less along the telegraph route, and from Urga I rode on to Russia, for some way along the Russian-Mongolian frontier. I made the actual distance between Kalgan and Urga across the Gobi desert 652 miles, and it was the most disagreeable journey I have ever made.

I did not sleep in a cart such as the lecturer has described, but I used to envy the gentlemen I saw in them. They were usually rich Chinese merchants. The cart was a sort of Rolls-Royce of carts ; one could sleep in it, and eat in it, and look out of a little window, whilst the cart was being drawn along by camels or ponies. These merchants sat in their carts and did not have to walk at all, and at night they slept in them and were very comfortable. I went in an ordinary Chinese cart.

There is a peculiar interest attaching to the Mongols, because they are the direct descendants of the famous hordes of the great Genghis Khan. In fact, when I was up in Urga I believe the Finance Minister of Mongolia could trace his descent from Genghis Khan himself.

On the question of water having an effect on the movement of the Chinese into Inner Mongolia, I rather take Sir John's view. All the wells that I came to in Outer and Inner Mongolia were nearly always full. There were, however, not many of them. Once in 80 miles I did not find a well ; and once when my horses were rather done, being a water finder, I managed with a clock-spring to find water for them. I got the Mongols to dig with some spades ; about 3 or 4 feet down there was water, and after a few hours there was sufficient to water the horses. That does not look as though Mongolia was getting short of water. Further, the Mongolian pony does not require much water ; he will go without it for two or three days.

When I went backwards and forwards along the Russian frontier in 1911 there were quite a number of Chinese colonists in the north of Mongolia. They were taking advantage there of a good country. The Mongol will not cultivate ; neither will he trade. He is a nomad, and so long as he can find grass for his

herds he is content. Being without ambition he will neither cultivate nor trade. The Chinese come along and do it. The Mongol is the laziest, the dirtiest, and the most extraordinary person you can find, but he has two good points: he is always cheerful and laughing, and he is perfectly contented with his lot. He is the most superstitious, most impossible person that one could possibly meet. I liked him however, in spite of his dirt, because he was always so cheerful.

In the latter part of 1911 the Russians excluded the Chinese altogether from Mongolia and forbade them to trade. That did not last very long, because they had to get the Chinese back, as the Mongol and the Russians could not get on without him. So he came back and sold his goods in the same way as before, for 5 per cent. on his turnover, and was content.

The PRESIDENT: You would, I am sure, wish that I should express, on your behalf, your gratitude to Mr. Buxton for his lecture this evening. I mentioned in introducing him that one of the stipulations of these Fellowships was that the man holding them should, as far as possible, enter into the inner life of the people amongst whom he travelled. Mr. Buxton certainly did his best to do that. On one occasion, he told me, though he has not told you this evening, that with a view to doing this he became a member of one of the rival armies fighting for supremacy in China—Wu Pei Fu's army. The success which he met with in his endeavours to enter into the inner life of the people is well illustrated by another little episode which he mentioned to me but not to you. After conversation with some Tibetan Lamas whom he encountered in that part of the world, he was cordially invited by two of them to accompany them on their long journey back to their own country, the reason apparently being that, judging him by his appearance, they thought he was a very martial person and that he could, therefore, accompany them as a warrior through the dangers of their journey home! He has told us much about Mongolia and the Mongols, and has shown us some excellent pictures. You are, I am sure, much indebted to him for the trouble which he has taken in instructing us in that part of the world on which he has been lecturing this evening.

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## RECENT DEVELOPMENTS OF AIR PHOTO-TOPOGRAPHY

*Read at the Afternoon Meeting of the Society, 19 March 1923.*

### I. The adjustment of air photographs to surveyed points.

Lieut.-Col. M. N. MacLeod, D.S.O., R.E.

AT the conclusion of the war the evolution of survey by aerial photography had reached a stage in which the aerial photograph was regarded mainly as a means of completing the detail on a map in which the main features had already been fixed. The methods of dealing with tilt distortion and of transferring this detail to the map evolved during the war are described in the *Geographical Journal* of June 1919. It will be observed in these methods that no attempt was then made to determine the amount and direction of the tilt. The adjustment, or plotting, of the photograph on the map was done direct without any preliminary processes.

It was known that some of the methods used were theoretically imperfect, while others were undoubtedly laborious. In the stress of war there had been little time for a study of the theory of the subject or for the elaboration of convenient methods and procedure. Enough experience, however, was obtained to show that aerial photography had great possibilities as an instrument of survey both in peace and war, and to indicate the general lines on which further development should be carried out.

The questions for consideration may be tabulated thus :

(1) The evolution of better methods for dealing with tilt distortion in flat country, in which some kind of framework or " control " already exists.

(2) The possibilities of using aerial photography to replace such a control or framework when it is found to be inadequate or is unobtainable.

(3) The best methods of dealing with hilly country, for determination of positions and heights.

It was soon evident that the solution of all three problems was dependent on the ability to make a satisfactory determination of the position in space of the camera and the direction of its optical axis at the moment of exposure.

This implies a determination of the following elements :

(i) The points of intersection of a vertical line through the centre of the lens with the photographic plate, the horizontal plane of reference, and the ground plane. These points are called the " Photo Plumb Point," the " Map Plumb Point," and the " Ground Plumb Point " respectively.

(ii) The height of the centre of the lens above the horizontal plane of reference.

When the photo plumb point has been found the amount and direction of tilt can be determined if the focal length of the camera and the intersection of its optical axis with the plate are known.

In the cameras used during the war no very exact determinations of focal length were made, nor was the optical centre of the plate indicated in any way. The first necessity for any further investigation was therefore to set about the construction of a camera specially designed for survey work. Such a camera has now been made by the R.A.F. and will be described by Major Laws.

In using this camera two courses are open to us : (*a*) to try and eliminate the question of tilt altogether, by straight and level flying, or by devising a form of mounting for the camera which will keep it always vertical ; (*b*) to allow the camera to move in the aeroplane and to devise some instrument for recording the departure of the optical axis from the vertical at each exposure.

The stabilizing of so heavy a thing as an air-survey camera was soon

seen to be impracticable, but Professor Melvill Jones at Cambridge has investigated the possibilities of level flying, and has shown that a great deal can be done in this direction, at any rate under peace conditions. Under war conditions it is however too much to hope that level flying will always be possible ; a satisfactory automatic tilt-recorder is therefore likely to be of more all-round value for military purposes than the ability to fly level. For such an instrument to be of use it is clearly necessary to perfect also a method of " rectifying " a tilted photo from the data given by the tilt records.

The methods of rectification evolved during the war did not depend on the knowledge of the tilt, but upon an examination of the relative positions of a certain number of control points fixed independently on the ground and identified on the photograph.

Experiments are now being made with a gyroscopic tilt recorder, but it is too early yet to say what success they will achieve. If it proves successful the tilt difficulty will be overcome, but the necessity for control points will still remain until some means can be devised of measuring the height above ground. The altimeters at present used will give height above the landing ground, but that of course is not what is required. Whether or no the tilt recorder proves successful, it is important, at any rate from a military point of view, to ensure that a certain minimum of control points is available.

The military aspect of aeroplane photographic surveying is handled by a committee of officers of the different services called the " Air Survey Committee." This Committee has to consider the problem of mapping regions in which no control points exist or can be fixed on the ground. It has accordingly initiated the construction of a special multiple camera designed entirely for the fixing of control points in an inaccessible area. This camera is essentially five separate cameras rigidly fixed together so that the plates form five contiguous sides of a cube. All are exposed simultaneously.

In principle it is a camera theodolite. The intention is to suspend it in the machine so that the central camera is pointed vertically downwards over previously surveyed ground and from the negative thus obtained to determine the height, tilt, and orientation of the whole apparatus. From this determination both horizontal and vertical between angles points appearing on the surrounding plates can be deduced. These angles may be deduced from linear measurements on the plates, or by means of the special form of theodolite called by the Germans a " Bild-Mess-Theodolite," and by us a " Photo-goniometer." Instruments for both purposes are being considered by the Committee, but no final conclusions have yet been reached as to the best designs for them.

The use of such a camera clearly depends on the ability to obtain a satisfactory solution of the " position in space " and the tilt from the central plate. As we cannot yet count on the possession of a satisfactory

tilt recorder, the Committee have considered also the various ways in which these elements may be found from control points.

There are three possible methods: (*a*) A graphic construction drawn out on the photograph; (*b*) computation depending on linear measurements on the photograph; (*c*) mechanical determination with the aid of special apparatus.

Graphic constructions have been investigated by Major King, R.E., and the Committee hope soon to publish a pamphlet on the subject embodying the results of his labours. The computation has been gone into very fully by Captain McCaw, and the results of his investigations have appeared in the minutes and proceedings of the Committee.

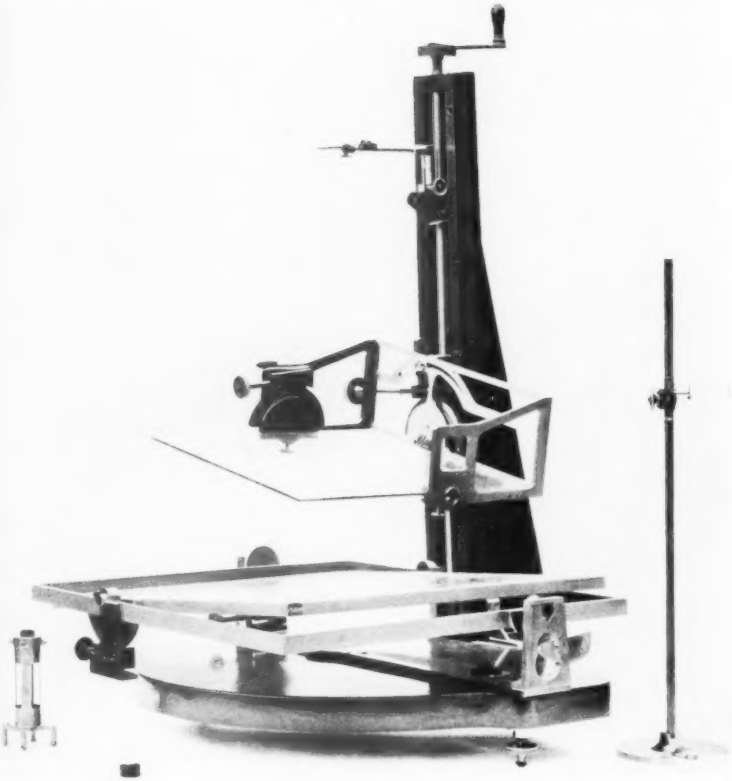
The mechanical determination of tilt depends on projecting the photograph in some way onto an adjustable screen, on which the control points can be plotted, and adjusting negative and screen until the points on the former project into their plotted positions on the latter. This is essentially the method employed in rectifying a tilted photograph with the object of transferring detail from it to the map, and referred to in the *Journal* of June 1919.

The camera lucida or the enlarging lantern can be used for this projection, but there are objections to both, although Commandant Rouissilhe has elaborated a method of using the enlarging lantern in this way. The Committee have, however, been sufficiently impressed with these objections to decide on the construction of a special apparatus, designed by myself, solely for the purpose of determining the tilt and the position in space. In this "tilt-finder" the projection is done by plotting the control points on a transparent screen and viewing the photograph, suitably enlarged, through the screen from a small eyehole. This gets rid of the difficulty of "focal length" which is the main objection to the enlarging lantern; and of parallax and different illumination of photograph and screen, which are the drawbacks of the camera lucida.

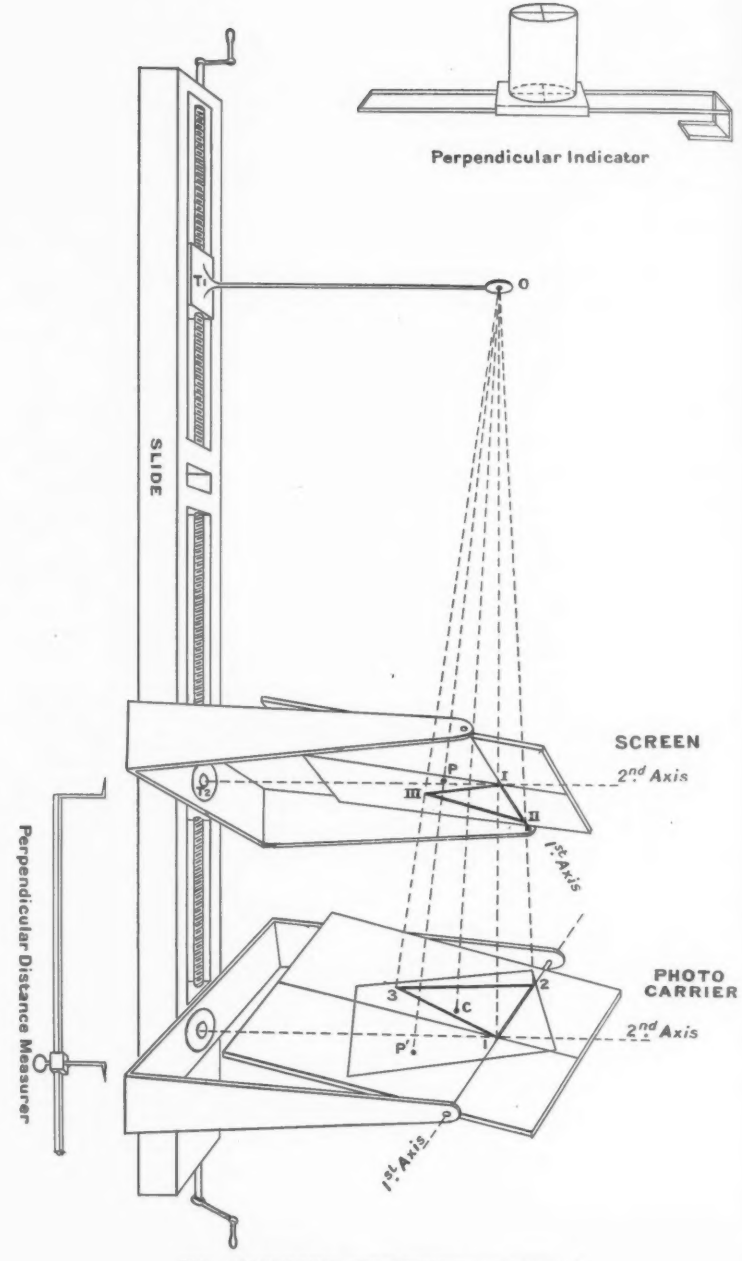
This tilt-finder can be made to reproduce the geometrical conditions of exposure, and also, if necessary, to allow for any inequality of the heights of the control points. The screen is mounted and the apparatus arranged in such a way that the coincidence, in projection, of the control points is obtained successively on a definite system. An experimental model constructed by the Ordnance Survey has been tried, and has proved sufficiently satisfactory to justify the construction of a new improved instrument, which is now in hand, by the R.A.F., Farnborough.

The ability to make use of control points of different heights without complicating the determination will be a very important advantage. At present the determination of tilt from control points in hilly country by computation or by graphic construction is most difficult, yet it is absolutely necessary as a preliminary to the solution of problems connected with heights and contours.

Determination of heights may be done in two ways. In theory if a



COL. MACLEOD'S TILT-FINDER: FIRST PATTERN




COL. MACLEOD'S TILT-FINDER: DIAGRAM

point can be photographed from two different aerial positions, and each of these photographs can be rectified, both its position and height can be found. The distortion due to height is radial from the plumb point, so that when two plumb points have been plotted a line can be drawn from each which passes through the map position of the point to be plotted. The intersection of these lines gives the map position, and the height of the point can be computed from the linear distances between this intersection and the actual positions of the point as it appears on the rectified photos.

Obviously the use of these principles will require accurate measurements on the photograph and accurate rectification. We cannot put them to practical tests until we are in possession of the various cameras and other apparatus now under construction. No doubt it would be a laborious matter to plot a photograph point by point in this way, but that may not be necessary. Contouring by plane-table after all consists in fixing instrumentally certain points and using them to control a sketch done otherwise solely by eye. The use of stereoscopic air photographs enables the relief of the ground to be seen fairly well, and if these are intelligently combined with plates used for plotting individual points it seems reasonable to expect that a fair approximation to the correct contours will be obtained without excessive labour.

At present some such procedure as this seems to be the only alternative, in hilly country, to the employment of expensive and complicated instruments such as the Autocartograph of Professor Hugershoff. This instrument was described in the *Journal* of April 1922, and it may be of interest to say that the makers have offered, as a test, to produce a map of an unspecified area in England from plates taken by us. This offer has been accepted by the Air Survey Committee and the necessary plates are on their way to Germany. The results will be awaited with considerable interest.

### Description of the Tilt-finder

The principle on which the working of the tilt-finder is based may be described thus:

In the theory of aerial photographic survey the photograph and the map are regarded as projections of the ground on plane surfaces from a centre defined by the photographic lens used.

The plane of the photograph is perpendicular to the optical axis which meets it at its centre, and at a distance from the perspective centre equal to the focal length of the lens.

The plane of the map is parallel to the ground at a distance from the centre depending on the height of the lens above ground and on the scale.

The relative positions of these planes are unknown, but if three points have been fixed on the map and can be identified on the photograph, and these points are marked or plotted on two planes (representing map and photograph) in such a way that one set can be made to project into the other, from a centre of projection placed with respect to the photograph similarly to the lens in the aerial camera, the relative positions of the two planes will be those occupied

by the planes of map and photograph in the geometrical conception of the theory.

This principle is well known and has hitherto been applied by projecting an image of the photograph onto a plane, corresponding to the plane of the map, on which the control points have been plotted.

In the tilt-finder the map is projected onto the photograph by plotting the map points on a transparent screen, and viewing the photograph through this screen from a pinhole placed in position relative to the photograph similar to that of the lens of the aerial camera.

The screen is adjustable, and the projective coincidence is obtained in a definite manner, which will be obvious when the working is described.

When the screen is adjusted the tilt is determined by dropping a perpendicular upon it from the pinhole, and projecting the point so found on to the photograph. This latter point is the "photo plumb point," and the line joining it to the centre of the photograph is the "principal line" which gives the direction of tilt. The magnitude of the tilt is computed from the distance apart of the principal and plumb points and the focal length.

The apparatus consists of one main and two separate auxiliary parts (see figure).

The main part comprises essentially: (*a*) The eyehole; (*b*) the screen; (*c*) the photo-carrier; (*d*) the slide or base.

The auxiliary parts consist of: (1) A perpendicular indicator (P.I.); (2) a perpendicular distance measurer (P.D.M.).

The whole apparatus is shown diagrammatically in the figure.

It will be seen that both screen and photo-carrier are mounted to revolve about two axes, so arranged that the line joining the intersections of these axes passes always through the eyehole. The "first axes" are always in one plane, which also contains the eyehole.

Eyehole and screen move independently on the slide, which is parallel to the line joining the intersections of the axes, referred to above. The instrument is used as follows:

1. *Preliminary adjustment.*

Suppose three control points have been marked on the photo, which must be enlarged to a scale appreciably greater than that of the map. Pin the photos to the photo-carrier so that one point (called the first point) falls exactly at the intersection of its axes of rotation, and another point (called the second point) is on the first axis. Centre the perpendicular indicator (called the P.I.) over the centre of the photograph and tilt the carrier until the two vanes of the P.I. are in line when viewed from the eyehole. At the same time move the eyehole along its slide, keeping the vanes in line until the eyehole is at the focal distance, or its enlarged equivalent, from the principal point (the P.D.M. is used to indicate the distance).

Clamp both eyehole and photo-carrier in these positions. Plot the control points on the screen in a similar manner, *i.e.* the first point at the intersection of its axis and the second point along the first axis.

Remove the P.I. and place the eye to the eyehole.

*Final adjustment.*

It can be seen from the mechanical arrangement that in all positions of the screen the "first points" are always in line and the second points always in one plane.

*Copyright*] [*Vandyk*

ERNEST HENRY SHACKLETON

1874—1922

# SHACKLETON MEMORIAL FUND.

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AT a meeting held at the Mansion House on May 8th a Committee was constituted with the object of promoting a National Memorial to Sir Ernest Shackleton.

The voyages which he planned in the *Nimrod*, the *Endurance*, and the *Quest* covered almost every side of Antarctic exploration. The history of the first two expeditions is the story, on the one hand, of originality and resourcefulness carrying him far beyond his predecessors, and on the other, of apparent failure triumphantly retrieved. In spite of the risks undertaken and the disasters faced and overcome, every man who sailed under Shackleton's direct command on either of these expeditions to the Antarctic was brought safely back; and had Shackleton lived to carry out the programme of the *Quest* a new chapter in the history of the exploration of the Southern Seas might well have been the result.

The Committee feel that, in the case of one who displayed such brilliant qualities of courage and leadership, it is a national duty that his memory should be perpetuated by some suitable memorial of a permanent nature, so that his example should be for ever an incentive to the youth of the Empire.

It is known that Sir Ernest Shackleton was a successful lecturer, and that he received large sums for film rights and for his books, but the money he obtained from these sources was never sufficient to meet the obligations he had himself incurred in endeavouring to complete the finance of his various expeditions. The *Endurance* expedition, though providing probably the greatest feat of successful leadership in the history of exploration, left Shackleton heavily in debt at a time when his sole thought, directly he returned, was to participate in the Great War.

Shackleton died as he had begun—a poor man. Those responsible for the Memorial wish to make it known, therefore, that one of their first objects will be to provide for the education of his children, and to take his place in supporting his mother. The balance that remains, after meeting these two obligations, will be devoted to the encouragement of exploration.

Cheques for Donations may be made payable to the National Provincial and Union Bank of England, Limited, for credit of "Shackleton Memorial Fund," and may be paid into any branch of that Bank, or may be sent direct to the Honorary Treasurer, Mr. Howard Button, C.B.E., Messrs. Chantrey, Button & Co., 61/62, Lincoln's Inn Fields, London, W.C.2.

## SHACKLETON MEMORIAL FUND.

### BANKER'S ORDER.

*To*

The National Provincial & Union Bank of England, Ltd.,
114, High Holborn, W.C.1.

*Sirs,*

*I send you herewith cheque £ ..... as a Donation to the* SHACKLETON MEMORIAL FUND.

*Yours truly,*

*Name and Title*.....

*Address*.....

.....

*Date*.....1923.

Projective coincidence of the second points can always be obtained by simply moving the screen along the slide. The first step in the adjustment is to effect this.

The "third-point" coincidence is obtained by tilting the screen about its two axes. Any rotation about the first axis will not affect the alignment of either first or second points, and the displacement of the second point caused by rotation about the second axis can immediately be corrected by moving the screen along the slide. There is consequently no difficulty about maintaining the alignment of the first and second points.

As the screen is tilted the effect on the alignment of the third points is at once apparent, and these can be brought into projective coincidence in a few minutes.

When all three points are lined up the screen is clamped, the P.I. placed on it, and moved about until the vanes are in line. The point on the screen so found and the corresponding point on the photo-carrier in prolongation of it are both marked. These are the "plumb-points."

The P.I. is removed and the P.D.M. placed between the eyehole and the plumb-point on the screen and the distance between them read off.

This completes the adjustment.

*The Mark II. model.*

The above description applies to the original model in which a glass screen was used. In this model allowance for height of control points can only be made by successive approximation, a preliminary rough determination of the position in space enabling corrections to be made to the plotting of the points.

In the new or Mark II. model the glass screen is replaced by a frame carrying a set of "markers" sliding on its edges; these markers are simply small circular transparent discs carrying a cross vane, but they can be screwed up or down perpendicular to the plane of the frame to a distance corresponding to the height of a point above or below the plane of reference.

## II. The mapping of large areas of unsurveyed country.

**B. Melvill Jones, M.A., A.F.C., Professor of Aeronautics, University of Cambridge, and Major J. C. Griffiths, M.Eng., B.Sc.**

We propose in this short paper to describe and summarize the results of research work that has been carried out at Cambridge University in the past two and a half years on air phototopography. The experiments were made possible by the co-operation of the Royal Air Force and the Board of Scientific and Industrial Research with the Chair of Aeronautics at Cambridge. They were suggested in the first place by Mr. Hamshaw Thomas of Cambridge as the result of his experiences on air mapping in Palestine during the war.

The problem we set out to solve was to find by what methods and with what degree of accuracy economical air mapping of large areas of moderately flat unsurveyed country could be carried out. We knew that resection methods were very costly, but that successful work had been done in Palestine by mosaic mapping from overlapping strips of

photographs, in which tilt and change of scale were reduced to a minimum by careful attention to straight and level flying of the aeroplane. We have carried out a thorough investigation on these lines and have succeeded in producing results which should be of considerable value in commercial surveying.

The problem of keeping constant height is quite simple; the only difficulty of the pilot is to do so consistently whilst concentrating on other operations. Unfortunately, the second problem of keeping the camera axis vertical is complicated by the fact that all forms of level indicators are disturbed by the horizontal accelerations of the aeroplane. Gyroscopical instruments can be devised which will seek the vertical so slowly as to average out these disturbances, but those of which we have had any experience are very delicate and liable to failure. In aerial surveying it is, however, necessary to fly very straight and steadily whilst taking the photographs, and under such conditions simple spirit-levels can be used to adjust the camera axis closely to the true vertical.

Now it is comparatively easy to fly straight and level with no other condition imposed, but it is much more difficult to do so when trying to pass over a pre-arranged point or track. The reason is that the pilot normally estimates the horizontal and vertical by reference to the horizon, and, when forced to look at the ground beneath him, is quite unable to distinguish the true from the apparent vertical as distorted by acceleration. Hence the flying accuracy attained on a survey of this nature will increase as the possible attention to the ground is decreased.

For convenience we decided to divide our experiments into two groups, as follows :—

(1) To study the accuracy with which it is possible to keep the camera at a constant height with its axis vertical when the difficulty of flying over the right ground is reduced to a minimum.

(2) To find out how to fly over the ground, so as to cover it with a series of straight parallel and overlapping strips of photographs without losing the accuracy obtainable above.

In connection with the first group of experiments, we were fortunate in having, near Cambridge, a stretch of very flat country covered with numerous well-mapped points and traversed by two large straight canals, over 20 miles long, called the Bedford Levels. It is possible to fly down a long straight landmark of this nature with very little attention to the ground, and thus to concentrate on keeping the aeroplane flying as straight and level as possible.

From photographs taken on a series of such flights we calculated, with great labour by resection methods, the tilt and height of the camera at the instant of exposure. After two years' work we obtained results for 170 exposures, and these showed a probable error of tilt of 1 degree from the vertical and a probable variation in height from the mean of a flight of 40 feet. From the same data we found that the tilt of the

camera seldom exceeded 2 degrees and the change of height from the mean of each flight seldom varied more than 100 feet. Experience in Palestine had led to the conclusion that such errors were not large enough to introduce serious errors in our mapping, and the first part of our research was thus completed to our satisfaction.

The second problem was to cover the ground without gaps and without losing accuracy. We have already stated that the accuracy of flying, and consequently of the resulting photographs, is inversely dependent on the attention paid to the ground beneath. The most logical and convenient way of maintaining the accuracy already determined in the first series of experiments will be, therefore, to permit location of the aeroplane by reference to the ground beneath only at the starting-points of the strips, and to fly by compass along the strips.

In order that the aeroplane may cover the ground in parallel strips on both out and return journeys, it will be necessary to find and allow for the wind at the survey height. With a well-trained crew, using suitable instruments, this operation can be carried out within ten minutes after reaching the height in question.

However well the compass courses are determined, the strips of successive runs will not be exactly parallel, and, since they are located at one end only, their length will be limited if gaps are to be avoided. We find this limit comes out between 10 to 15 miles.

Before the detailed survey can be carried out it will be necessary, however, to provide the pilot with strips of photographs marked with the starting and ending points of his mosaic strips. These photographs or indication strips will necessarily be taken at right angles to the mosaic strips.

Provided with this strip map, the pilot will begin on his detail survey by getting over starting-points as accurately as he can and then taking up his pre-calculated compass bearing as quickly as possible. A difficulty may here be experienced owing to the well-known fact that compasses on aeroplanes are affected by a change of course and do not settle down on a true bearing until the aeroplane has been flying straight and steadily for some time. If the pilot has managed to get over the starting-point whilst flying on the correct bearing, this difficulty will not arise, but when working from tractor aeroplanes, as we are forced to do, one cannot always manage this because the lower plane obstructs the view of the point during the approach, unless this approach is made in a curve.

To overcome the difficulty we use a gyroscopical apparatus designed by the Royal Aircraft Establishment. The instrument or gyro-azimuth, as it is called, registers direction in azimuth but is not subject to turning errors, like the compass. We consider that an instrument of this nature is of great value in aerial surveying.

The photographic strips themselves can be kept straight by flying

on a distant point near the horizon and using the compass, but this operation can be much assisted by another gyro instrument that controls the rudder through a relay and thus keeps the aeroplane on a straight course automatically. This apparatus relieves the pilot of the most fatiguing part of his work, and, by allowing him to concentrate more on such things as maintaining constant height and speed, improves the general quality of his work. We have carried out surveys both with and without this instrument, and, whilst we have proved that accurate work can be done without it, we should always recommend its use in any large surveying scheme.

*Compilation.*—We have found by experience that 100 square miles is about the area that can be conveniently covered in one flight lasting three hours. It is also a convenient size if compiled as a mosaic 10 miles to a side. The method, therefore, that we favour for mapping large areas, is to compile the prints of each day's work into separate mosaics, and, after reproducing these to any required scale in a large camera or photostat, to fit these larger units together in the same way as the individual prints were fitted.

Mosaics of this size must be compiled in a systematic manner to avoid the accumulation of errors. We begin the compilation by laying down each strip separately and securing, to the back of the strip, lengths of stretched elastic fixed to each print at one spot by a dab of seccotine. When all the strips have been so treated, we lay them side by side upon a table and stretch and bend them systematically until we have got the best general fit that can be obtained without detail handling of the prints.

A final adjustment is then made in which attention is given separately to each print, but no print is moved far from the position it has taken in the systematic adjustment.

We have compiled two mosaics $15 \times 7\frac{1}{2}$ miles each and found the distortions by comparison with Ordnance Maps. In one case in an area of $10 \times 5$ miles there was no distortion greater than 100 yards; in the other case, where the gyroscopical rudder control had been used, the results were even better, errors in a similar area being less than 60 yards, and no point at all was displaced more than 100 yards. The average scale of both mosaics came out to 1/19,800 as against 1/20,000 intended.

*Compiling to Control Points.*—We next compiled the two mosaics into one single 15-mile square and adjusted it by systematic straining to fit four control points forming a rough 10-miles square. In this case we found that the distortional errors were less than 60 yards within the control square, whilst the maximum error was no greater than 130 yards, and occurred on that part of the mosaic that was made without the use of the gyro-rudder control. The scale of the control points was determined after the preliminary adjustment, and came out as 1/19,930.

The country of which this map was made contains local differences

of level up to 300 feet in several places, and on the extreme southern edge rises to 500 feet above the lowest part.

We exhibit this map. It is *not*, of course, shown as a good example of photographic technique, because the plates used had lost their sensitivity through age.

*Navigational Control.*—In some types of country control points 10 miles apart may not be obtainable. We have in hand a scheme for navigational control that might be used to give quite a good measure of position between very widely spaced ground-surveyed points. The scheme depends upon taking the preliminary identification strips along straight parallel lines of about 50 miles length. The plates in these flights are taken at exactly equal time intervals, and the positions of the end of the strips are known by ground control. We estimate on good but not conclusive evidence that using these indication strips together with a few strips running at right angles, we could so distribute errors as to locate the 100-mile square units within $\frac{1}{4}$ to $\frac{1}{2}$ mile when the control points are 50 miles apart.

To obtain results of the above orders of accuracy, trained and picked crews using suitable aeroplanes specially equipped are absolutely necessary.

Before the papers the PRESIDENT said: The subject of this afternoon's discussion is to be "Recent Developments of Air Phototopography," and we are to have papers on that subject by Colonel MacLeod, a member of the Air Survey Committee; by Squadron-Leader Laws, who is chiefly concerned, I think, with the photographic work of the Air Force; and by Major Griffiths, who has been associated with Professor Melvill Jones at the School of Aeronautical Engineering at Cambridge. The subject is naturally a somewhat technical one, and I do not therefore propose to stand between you and the lecturers. I will ask Colonel MacLeod to give us his paper.

*Colonel MacLeod and Major Griffiths then read the papers printed above; Squadron-Leader Laws described apparatus and methods not yet ready for publication, and a discussion followed.*

Prof. MELVILL JONES (School of Aeronautical Engineering, Cambridge): Listening to the first two papers, it occurred to me that you might have got the impression from them, as they were both very much condensed, that we are all working at cross purposes. First we saw work by Colonel MacLeod, aiming entirely at resection processes; and then we had a short account of our work at Cambridge, which does not concern itself with resection but goes straight for trying to keep the camera vertical. We are not actually working at cross purpose but in very close touch, although we have apportioned the work into two different parts. We are not working at cross purpose, because so many different kinds of surveying are required. In some circumstances one wants high accuracy and has time and money to get it; on other occasions, as when breaking new ground in new country of enormous size, one cannot spend much per square mile and one does not require very great accuracy.

What we are aiming at at Cambridge is to find methods by which one can get a moderately accurate map without the great labour involved in dealing with

separate photographs by geometrical methods. But of course that is only one side of the question.

The work we have done at Cambridge really divided itself into two parts which are quite distinct: the first part consisted of a general research into the accuracy with which one can fly straight and level. That was done, not only from the point of view of developing the later work Major Griffiths explained, but because such knowledge is the basis of all future work in aerial surveying, what evermethods are used. For instance, Squadron-Leader Laws referred to a little gyroscopical instrument which it is hoped will indicate the vertical on the photograph itself. Such an instrument will not indicate an absolute vertical, but merely some proportion of the oscillations of the aeroplane. If the aeroplane is swinging through 5° that instrument might cut down the swing to 1°; if the aeroplane only swings through 1° it might cut it down to a fifth of a degree, and so on. Even if you use instruments of this nature it is thus essential to know something about the oscillations of the aeroplane itself. The next part of the work was very much more specialized; it resulted in the production of the map which appears for your inspection, and consisted in attempts to get moderately accurate results by simple means, using prints straight from the original negatives without any reprojection.

There is one point in which I differ slightly from the rest of those who have spoken. I think some of the speakers are over-afraid of the danger of not being able to fly straight and level in war-time. I thoroughly appreciate that it is of the greatest importance that methods should be developed which can be used when you cannot fly straight and level, but there are two aspects of that matter to which I should like to call your attention. One is, that unless you can fly straight it is extraordinarily difficult to make a map at all, because you do not cover the ground properly. The other is, that I do not think that it will be so difficult to obtain straight flying in future war. I admit that in surveying in war-time in France it was often impossible to fly straight on account of anti-aircraft fire; but I think it is highly improbable that the next war, if there should be one, will be anything like the war in France. In the first place the heavy concentration of the anti-aircraft fire in France depended on the fact that the front remained practically stationary for some years, and in the second place I think it probable that photographic surveying in war-time will be carried out from such great heights—say 30,000 feet—that the aeroplanes will be very difficult indeed to hit. Even in the last war photographic aeroplanes at 20,000 feet experienced very little interference from anti-aircraft fire.

Admiral LEARMONTH (Hydrographer): As it is now getting late I will only refer particularly to what applies to aerial photography in connection with nautical surveying and hydrographical work. It might appear at first sight that there is not much necessity or requirement in that direction, but that is not so. Nautical surveyors welcome the advent of aerial photography, and its application to their work will undoubtedly fill a large gap which often exists in particular circumstances. When the perfection that is now being aimed at has been attained, the rapidity of execution of certain features of nautical surveys will be very much enhanced. Aerial photography can be used with advantage when delineating the features of extended lengths of coastline and its belt, which is what the nautical surveyor is more particularly concerned with, and photography would be helpful in such cases where the coast is difficult of access by reason of the prevailing surf, or fronted with extensive reefs which prevent a near approach. Again, there are many instances where aerial photography can be used with advantage in delineating long stretches of reefs

and shoals, such as the Barrier Reef in Australia, and for coral-strewn seas many of which are not even outlined and wait to be charted. The method can also be applied very usefully where there is a very large rise and fall of the tide, if it is desired to delineate the extent of the shoals and reefs or strands at the maximum occasions of low water. The alternative is the laborious method of attempting to delineate such areas by visiting them, which at the best yields comparatively imperfect results notwithstanding the labour involved. These are just a few illustrations.

A rather forcible example of the great use of aerial photography happened only a short while ago. During the recent period of tension in the Mediterranean a vessel of deep draught struck an " obstruction " whilst proceeding through a well-known highway in the Ægean Sea, and used by every class of ship. She was in mid-channel with every indication of oceanic depths, and there was no occasion to suppose that there was any likelihood of hidden danger. The vessel received such injury as to require docking. On the circumstances being reported examination indicated that the " obstruction " might prove to be a hitherto unknown rock. In view of the situation at the time it was not desirable to despatch any vessel to make a special survey of the area. However, aircraft were used as an alternative, with the result that within a very short period the obstruction was located by means of aerial photography under favourable conditions of visibility, and proved to be a comparatively small undetected pinnacle rock which, apart from other features, might have been the cause of any vessel on striking it slipping off and foundering in the surrounding deep water. This is undoubtedly a forcible example of the application of photography to aerial surveying, and I do not think I can give a better one.

It will doubtless be recollected by many who occupied any position of responsibility and were interested or concerned in the various branches of surveying, that they were approached from many directions very shortly after peace was signed to apply photography to surveying. Most of us, whether technical experts or not, at once appreciated that there were difficulties to be overcome before this would be possible. How complicated these are, and how skilfully they have been investigated and are being dealt with, is to my mind, one of the lessons to be learned from, and which has been so well illustrated in, the three lectures that have been delivered, together with the excellent slides that have been shown.

The PRESIDENT: Air-phototopography was suggested as a subject for discussion at one of our afternoon meetings by Colonel Winterbotham, who is present. He might like to say a few words on the matter.

Colonel WINTERBOTHAM: Air phototopography is essentially the product of the labours of three craftsmen: the navigator who flies the plane, the photographer who takes the photographs, and the surveyor who uses them. It has been extraordinarily interesting, I think, and I hope others think the same, to have had three papers from the three people interested outlining their own particular share of the work.

Speaking for the Air Survey Committee, we surveyors and photographers know that we have still many strides to make before the groundwork has been dealt with. But the Committee was glad to take this opportunity of explaining the progress that has been made up to date, and more particularly so at a meeting at which Professor Melvill Jones was to deal with the improvements in navigation during photography which are so essential and which have not been taken up by us. Unlike Professor Melvill Jones, we look forward to a terrible war in which the navigator will have few opportunities of flying straight.

Not only do we look forward to such conditions in the air but also to the photographic contouring of the map we are to make. The problem cannot be solved if we regard the Earth as a plane. One of the first troubles that a surveyor meets with is that the world is not a plane but a spheroid with bumps on it, and, that being so we are compelled to think of survey in three instead of in two dimensions.

Having spoken so far for the Committee, I would like to add one personal conviction. There are people who regard air-photo surveying as something which must either sweep away all old-fashioned methods of surveying and take their place or fail in the struggle and be abandoned itself. Surveyors have arrived at new methods of measurement for centuries. No one of them has succeeded in entirely displacing the methods of his predecessors, nor does it seem in the least bit probable that the aerial camera has come to do that either. For years, probably for ever, the ordinary trigonometrical control will be the basis for all surveying; probably for ever there will be gaps in the air phototopography which will have to be filled up on the ground; and probably also it will remain a fact that certain types of country will, most economically and most efficiently, be mapped by other means. We want phototopography to come as the friend and ally of the man on the ground, and we look forward to a time when a survey party will be composed of people who will bring out their aeroplanes, as we poor people do our bicycles and the wealthier ones their cars, who will fly out to the scene of their trigonometrical observations, taking photographs on the way, and perhaps casting an eagle eye on some lazy plane-tabler who thinks he is escaping observation!

The PRESIDENT: I understand that Mr. Hamshaw Thomas, who was a pioneer of this work in Palestine during the war, is present, and we shall all be very glad if he will say a few words.

Mr. HAMSHAW THOMAS: When I saw the admirable results and the delightful film camera which Squadron-Leader Laws showed, I could not help thinking of the time when I was trying to make a start in survey work with our first film camera in 1917 in Sinai and Palestine, when I was literally, as well as figuratively, a voice crying in the wilderness. The only contribution I can make to the discussion is possibly a remark or two suggested by the practical experience which I had in the East on attempting this work. It is obvious that our methods were very crude and rough, but nevertheless we did succeed in doing something. My chief criticism is that one is going to have difficulty with the compound camera and with any system which uses oblique photographs in a country which is comparatively lacking in features. In England, as we saw from the photographs shown on the screen, you can easily pick out known points—the woods, churches, houses or farms, or the conspicuous trees or hedges, and so on. But very often when one employed this method in a country such as the eastern part of Palestine, we were met by the situation in which a pilot and observer were sent out to take oblique photographs of a strip of country quite well known, and when they came back twelve or fifteen of the photographs could not be identified by any manner of means, even though we had quite a good 1/40,000 map of the country over which the photographs were taken. No feature was seen in the prints which would be shown on a map, and nothing could be done with the photographs, That sort of thing happened time after time, and it makes me think that if the multiple-camera method and oblique photographs are to be used, possibly it will be necessary to have some system of signals, or helio reflectors. I know the heliograph system was tried in India but not found to be a great success,

but I think I may say that those experiments on aerial survey in India ('Professional Paper No. 19, Survey of India,' 1920) ought not to be regarded as a very important contribution to this subject, because they were very seriously hampered by the employment of inexperienced pilots and observers who had not been previously trained for the work, as well as by a very imperfect equipment. Therefore, possibly something can be done, either by the helio method of signals, or in some other way, if more practised pilots and observers were employed.

Prof. Jones touched on one aspect that I intended to speak about, and if I am not wearying you I should like to emphasize again the fact that we must have progress in different methods, if aerial survey as a whole is to proceed. The method which is best for one sort of country is quite inapplicable to another. The method which Major Griffiths has spoken about—the ordinary adjusted series of vertical photographs such as we used in Palestine—is quite inapplicable to very mountainous countries where I think that nothing except the oblique method or some of the newest types of compound camera can be used.

There is just one other little point which may interest some of you, though it is really off the main trend of the discussion. We have taken from Cambridge some rather interesting series of photographs of coastal areas during the last year or two, and there are exhibited here to-night examples of two surveys taken over Blakeney Point in Norfolk. These have brought out a noteworthy feature, the extraordinary detail in which one can get the nature of the ground depicted by air photographs. We found firstly in that coastal area that the coast was changing very rapidly indeed. In some cases there were changes in the length of a shingle spit of at least 100 yards in a month. Secondly, as soon as one becomes a little acquainted with the area, one can see where the changes will take place and which areas are stabilized by vegetation. One can distinguish places where the sea may break through the shingle bank during any storm, and by quite a small amount of study of the ground one can get a great deal of detail as to the various levels of the parts of the land adjoining the sea without any careful measurements. I think that the aspect ought to be kept in mind, and as further experiments are made in methods of surveying I think some notes would be very useful from the point of view of the ground features and their illustration in air photographs, somewhat of the same type as we used to have in the Army. I think the interpretation of air photographs still has some practical utility, and will have in future a bearing on survey work.

The PRESIDENT: I do not know, in view of the reference which has been made to the experiments carried out in India in connection with heliographic signalling, whether Colonel Crosthwait of the Indian Survey would care to say anything.

Colonel CROSTHWAIT: On perusing proofs of these papers I saw immediately what great advances had been made since I was in India. The only point that I should like to mention is that the photographs which I had to do with were taken on the North-West Frontier during the Waziristan Expedition, and they were taken more for intelligence than for mapping. The photographers were rather inexperienced and there were often many gaps in the work. Also, even if they had been flying with a vertical camera, with the optical axis vertical, the ground was constantly rising and they were flying, as it were, down an inclined plane with reference to the ground, so that the ground was constantly approaching the camera. This made great difficulties as regards scale.

In fact, it was very difficult to ascertain the scale because there were no maps and no points. We knew, because of the difficulty of joining the various photographs, that the scale was varying from one cause or another.

Then again, there is an enormous local difference of height. The advance was made up the Takki Zan Nullah, which is deep and narrow, and the troops were practically confined to the nullah with their outposts on the adjacent hills, so that it was very difficult to produce anything for survey purposes from the photographs. But I thought they were of great value from a reconnaissance point of view, because of the difficulty of seeing what was in front. The nullah winds about so that when you look ahead you see very little that is in front of you, that is to say the view is completely blocked out. When the photographs were taken we made a mosaic and reproduced them by the half-tone process, so that we could give copies to the staff and they could, therefore, get a good idea of the kind of ground in front of them—a view, as it were, of what was behind the wall. So that, from this point of view, I think the photographs could be made very useful on the North-West Frontier.

The other use we made of photographs in India was for making town-guide maps. We made quite a number of guide maps of the Indian cities, which are extremely complicated, and we were able to make these maps very easily from the photographs. It was not a question of very accurate scale, though, as a matter of fact, the scale was accurate because most of the Indian cities are level; the ground had to be gone over to interpret the photographs, but they showed very well the complicated streets and lanes, which it was the purpose of these maps to elucidate.

The PRESIDENT: I am quite sure that I could not add anything of value to the discussion which has taken place, and I propose therefore to confine myself to expressing on your behalf your gratitude to the lecturers for coming and giving these explanations to us. Both the explanations which they have given and the photographs which they have shown us must have given us a fair idea of the immense difficulty of the problems which they are in process of solving, but which have by no means in all cases, at any rate, yet reached solution. I am sure you are as grateful to them as I am for the trouble which they have taken to make these things clear to us this afternoon. I express our great thanks to them.

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## THE SALTS OF THE DEAD SEA AND RIVER JORDAN

Wilfred Irwin

*Read at the Afternoon Meeting of the Society*, 16 *April* 1923.

SHORTLY before the War I visited Palestine, and included the Dead Sea and the river Jordan in my itinerary. The general appearance of the scenery of that strange district does not need description. Many references to the Dead Sea are to be found in Jewish and classical literature. Pausanias and Galen both mention it, and Tacitus and Josephus note the fact that boats navigated it. During the Crusades a considerable revenue was received from navigation dues. In more recent times this

has all disappeared, and a solitary boat was the only craft left before the War when the Sultan claimed the sea as his personal property.

The river Jordan supplies almost the whole of the water received by the Dead Sea, to which there is no outlet. The principal sources of the Jordan are two immense springs near the foot of the snow-clad Mount Hermon, Ain Banias, and Ain el Leddan. A longer tributary but of much less volume comes down from Lebanon, the Nahr el Hasbani, and another little tributary is the Nahr Bareighit. These unite to form the river, which soon widens into a swampy expanse which is very fertile, and at the lower end is lake Huleh, or " Waters of Merom," 4 miles long and 2½ broad, but shallow, and even now, though so near the source of the river, only 7 feet above sea-level. The water here holds in suspension a brownish flocculent precipitate which does not improve its appearance.

On leaving the lake the river runs as a " below sea-level " torrent forming one cascade after another through a 10-mile course in which the fall is 687 feet, after which it widens out into the Sea of Galilee, 14 miles long and 7 miles broad, area about 65 square miles, and greatest depth 150 feet, according to Merrill and Barvis, though earlier authorities give it as much as 800 feet. Two miles south of Tiberias is a hot spring which in Roman times had a great reputation for its curative powers. The water feels quite hot to the hand. I had not a thermometer when I visited it, but I understand it has a temperature of 137° to 140° F. The temperature of the lake below a depth of 50 feet is 59° F., showing that the water retains some of the coolness it receives in the internal reservoirs of Mount Hermon, though the climate is sub-tropical. The river, which is brown on entering the lake, is clear on leaving it, as the precipitate has had plenty of time to settle. Assuming the average depth of the lake to be 80 feet and the flow of the river 1000 million gallons per day, it would take 2¼ years for the water of the Jordan to pass through it.

From its outlet from the Sea of Galilee the river commences its zigzag course to the Dead Sea 60 miles south, but in its windings it actually traverses three times that distance. Five miles from the lake it is joined by its largest tributary, Nahr el Yarmuk, rising in the Hauran. This river, after flowing for some distance at an elevation of 2000 feet above the Mediterranean, falls down a series of grand cascades through 2000 to 3000 feet before it reaches the Jordan. Owing to the soft calcareous strata over which the Jordan after leaving the Sea of Galilee flows, and the tributaries which join it, it soon develops a milky appearance like most of the other streams of Palestine. Naaman the Syrian, we may remember, made the observation in his day, " Are not Abana and Pharpar rivers of Demascus better than all the waters of Israel?" The former were clear, the latter milky streams. In its course of 180 miles to the Dead Sea the Jordan falls another 610 feet, on its way receiving two other tributaries of some size, the Wadi Farah from the west, and the

Wadi Zerka from the east, both entering it about 25 miles north of the Dead Sea.

Captain Lynch made a careful survey of the Dead Sea in 1860. He found the length 47 miles, breadth 9½ miles, area 340 square miles, greatest depth 1279 feet.

I calculate the area of the catchment at about 10,000 square miles, but the rainfall in it varies enormously. In Hermon and among the mountains to the north it is extremely heavy. In Galilee it is given as 66 cms. or 26 inches; then it diminishes all the way to the Dead Sea. After the confluence of the Jordan with the Farah, the land not irrigated is practically barren, and at the Dead Sea the rainfall is very slight. With the exception of a few oases due to the presence of springs, all the land from the Farah to the rising ground south of the Dead Sea is wilderness.

The average depth of the Dead Sea will be 400–500 feet, and taking the former figure as a basis we may work out the total quantity of water in it as $23{\cdot}7 \times 10^{12}$ gallons. In the northern part the water is clear down to the stones on the bottom, but further south where the solution is more concentrated, the floor of the sea is all solid salt mixed with sulphate and carbonate of lime. The southern end is very shallow, and round the southern banks are great masses of solid salt. This may be due to the land at the south of the sea having risen owing to the same influence which caused the elevation of the land between the Dead Sea and the Gulf of Akaba. The peninsula "El Lisan" is chiefly composed of sulphate of lime interspersed with beds of salt. In certain parts in thundery weather a quantity of asphaltum rises to the surface. Hence the ancient name "Lacus Asphaltites." The colour at the time of my visit was bottle-green. A sample which I took from the north end had a specific gravity 1·150 and the boiling point 105° C., or 221° F. At 300 metres below the surface at the deepest part the specific gravity is 1·253, and it is about the same at the southern end. At this specific gravity the solution is saturated to sodium chloride as well as calcium sulphate, and these salts are continually crystallizing out.

The most exhaustive analyses of the Dead Sea water have been made by Terreil (see *Comptes Rendus*, 62, 1329), and the following are six analyses by him. He first determines the salinity in grammes per 100, and then gives the analysis of the solid matter contained.

| | | | | |
|---|---|---|---|---|
| A | Surface water, north end. | | | |
| B | 20 metres deep | 5 miles east of Wady Meabba. | | |
| C | 42 ,, | ,, | Ras Mersid. | |
| D | 120 ,, | ,, | 5 miles east of Ras Fesch Ka. | |
| E | 200 ,, | ,, | ,, | ,, |
| F | 300 ,, | ,, | ,, | ,, |

The results are (note: T = Trace):

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| Chlorine, Cl ... ... | 65·81 | 70·25 | 68·16 | 67·66 | 67·84 | 67·30 |
| Bromine, Br ... ... | 2·37 | 1·55 | 1·99 | 1·98 | 1·75 | 2·72 |
| Sulphate, $SO_4$ . | 0·31 | 0·21 | 0·22 | 0·22 | 0·22 | 0·24 |
| Carbonate, $CO_3$ .. | T | T | T | T | T | T |
| Sodium, Na ... ... | 11·65 | 6·33 | 10·21 | 10·20 | 10·00 | 5·50 |
| Potassium, K ... | 1·85 | 1·70 | 1·00 | 1·60 | 1·79 | 1·68 |
| Calcium, Ca ... ... | 4·73 | 5·54 | 1·53 | 1·51 | 1·68 | 6·64 |
| Magnesium, Mg ... | 13·20 | 14·40 | 16·80 | 16·80 | 16·70 | 15·99 |
| Silica, $SiO_2$ ... ... | T | T | T | T | T | T |
| | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 |
| Total solids in grammes per 100 grms. of the liquid ... ... | 19·2 | 20·7 | 24·2 | 24·5 | 25·1 | 25·9 |

These analyses show considerable variations according to the spot from which the sample is taken, but the total solids do not greatly vary. The principal constituents, it will be seen, are magnesium and sodium chlorides. Comparing the extremes, A and F, we find the outstanding change to be that the sodium salts show a decrease, and the magnesium salts an increase on passing from the north to the south and to the deepest part of the centre of the lake. This alteration can be caused only by the sodium salts crystallizing out on the bottom, and leaving the more soluble magnesium salts in solution, forming what we call in our factories a mother liquor.

The following is an analysis which I made some time ago of a sample taken by myself from the north end of the lake :

| | | | |
|---|---|---|---|
| Chlorine, Cl ... ... ... | 66·46 | Sodium chloride ... ... | 7·17 |
| Bromine, Br ... ... ... | | Magnesium chloride ... | 9·50 |
| Sulphate, $SO_4$ ... ... ... | 0·46 | Calcium chloride ... ... | 2·18 |
| Sodium, Na ... ... ... | 14·41 | Potassium chloride ... | 0·55 |
| Potassium, K ... ... ... | 1·48 | Calcium sulphate ... ... | 0·13 |
| Calcium, Ca ... ... ... | 4·26 | | |
| Magnesium, Mg ... ... | 12·29 | Total solids ... ... | 19·53 |
| Silica and carbonic acid ... | Trace | Water by difference ... | 80·47 |
| | 99·36 | | 100·00 |

Taking the figure $23\,7 \times 10^{12}$ as representing the number of gallons of water in the Dead Sea, and the average total salinity at 24 parts per 100, or 2·4 lbs. per gallon, a figure below rather than above the mark, then the total solids in solution will be $56{\cdot}8 \times 10^{12}$ lbs. Of this, magnesium may be taken to average 16 per cent. or $9{\cdot}1 \times 10^{12}$ lbs., and the sodium in the total solids at 10 per cent., or $5{\cdot}7 \times 10^{12}$ lbs. These metals are both present as chlorides, which will then amount to :

| | |
|---|---|
| $MgCl_2$, magnesium chloride ... | $36{\cdot}0 \times 10^{12}$ lbs. or $16{\cdot}1 \times 10^9$ tons. |
| NaCl, sodium chloride ... ... | $14{\cdot}5 \times 10^{12}$ lbs. or $6{\cdot}5 \times 10^9$ ,, |

A few years ago, in order to determine the influence which proximity to the sea had on the chloride salinity of rain-water, and further to what degree the chlorides in rain-water at different distances from the sea influenced the chlorine contents in the rivers and lakes of the Cumberland district, I made a great many tests of the rain and river water as well as of all the lakes in Cumberland and Westmorland.

The following table shows the chlorine contents calculated as NaCl in some of the rivers:

| | | | |
|---|---|---|---|
| River Eden at Carlisle ... ... | 15·0 | parts | NaCl per million. |
| „ Derwent at Cockermouth | 17·0 | „ | „ |
| „ Eamont at Penrith ... | 11·5 | „ | „ |
| „ Greta at Keswick ... ... | 11·0 | „ | „ |
| „ Cocker at Cockermouth ... | 15·0 | „ | „ |
| „ Tees at Middleton ... | 13·0 | „ | „ |

It then occurred to me to test my sample of Jordan water in the same way for comparison. I did so, and found to my great surprise the Cl equal to 600 parts of NaCl per million. The sample had been opened many times during the years that I had kept it, and it may have lost a very little water by evaporation, but certainly not much, and the salt contents must have been at least forty times as great as in an average uncontaminated English river. Had I known previously that the Jordan was a saline river I would have taken further samples, and in quantity sufficient to make complete analyses, but I was not previously aware of that fact.

As soon as I tested it I said, Surely this must be the main source of salt in the Dead Sea, and the next question to be answered was, Whence did the Jordan derive its salinity? In a paper recently read before the Geographical Society Dr. Masterman suggested spray from the sea carried down by the rain as a source. From my experiments previously referred to I should say 4 to 5 parts of chloride per million is as much as the Jordan is likely to receive from this source, and as it contains nearly 100 times this quantity the proportion due to spray must be very small.

With a view to determining the source of the salts in the Jordan I obtained through the kindness of Mr. T. Cortas of the Friends' Syrian Mission three samples of its water, the first from the Waters of Merom, the second from the entrance to Sea of Galilee, the third from outflow from Sea of Galilee. I have tested these and compared them with the analysis of the river Jordan at Jericho by Saaches, and of the Sea of Galilee by Christie. The sample taken from the Waters of Merom had a specific gravity 1·00056. It contained a brownish flocculent precipitate chiefly consisting of organic material with a little oxide of iron. The same precipitate was in evidence at the entrance to the Sea of Galilee, but had disappeared from the outflow, which was clear. At Jericho the river contained a milky-white precipitate of carbonate of lime which deposited again in the Dead Sea.

The following are the analyses in grams per 100 c.c. :

| | *Waters of Merom.* | *Inlet to Galilee.* | *Outlet from Galilee.* | *Galilee. (Christie.)* | *Jordan at Jericho. (Saaches.)* |
|---|---|---|---|---|---|
| Sodium, Na ... ... | 0·0128 | 0·0128 | 0·0133 | 0·0121 | 0·0139 |
| Magnesium, Mg ... | 0·0026 | 0·0026 | 0·00285 | 0·0023 | 0·0037 |
| Chlorine, Cl ... ... | 0·0230 | 0·0230 | 0·0240 | 0·024 | 0·0318 |
| Calcium, Ca ... ... | 0·0056 | 0·0056 | 0·0048 | 0·0049 | 0·0082 |
| Sulphate, $SO_4$ ... ... | 0·0039 | 0·0039 | 0·0038 | 0·0016 | 0·0015 |
| Silica, $SiO_2$ ... ... | 0·0017 | 0·0013 | 0·0013 | 0·0013 | 0·0015 |
| Potassium, K ... ... | — | — | — | — | 0·0008 |
| $CO_3$ ... ... ... | — | — | — | 0·0075 | 0·0100 |

My own test of the water of the Jordan taken near Jericho gave 0·0364 grm. chlorine in 100 c.c. I had not sufficient for full analysis.

These analyses show (*a*) the extraordinary fact that the river, so near its source as the Waters of Merom, is already highly impregnated with salts, chiefly the chlorides of sodium and magnesium ; (*b*) that between Merom and the Sea of Galilee there is no change in its composition ; (*c*) that on its passage through the Sea of Galilee there is a slight increase in its contents of sodium and magnesium chlorides, but a decrease in calcium, sulphate, and silica, no doubt by precipitation of $CaSO_4$ and $SiO_2$ in the lake. This slight increase of chlorides may be due to saline springs near the north-west shore of the lake, or it may be due to the evaporation from the lake being greater than the addition from rainfall and tributaries flowing into the lake. The rainfall of the district is low—25 inches, and the climate sub-tropical.

From the fourth column we note that there has been no great alteration in the composition of the lake since Christie tested its waters many years ago.

By the time the river reaches Jericho we find an increase in most of the salts, especially magnesium chloride. The increase of chloride is 30 per cent., so it would seem that between the Sea of Galilee and Jericho the river receives from some source a definite addition to its salinity, for the tributaries falling into it must more than equal the evaporation. It is however many years since Saaches' sample was taken and analysed, and a change in the composition may have taken place in the interval. My sample taken in 1914 is fairly in agreement with Saaches, especially when account is taken of the fact that it was a very small one, and has been opened many times over in the years that I had it prior to analysis.

Infiltration from the Mediterranean is not a probable source of salt in the Jordan, because the Waters of Merom are above the level of the sea, and because the proportion of magnesium to sodium is much greater in the Jordan water than in the Mediterranean Sea water. The greater part of the salt in the Jordan as it enters the Dead Sea must therefore have come all the way down from its home in the subterranean recesses of Hermon and possibly Lebanon.

The previous geological history of the Jordan gorge would not lead one to expect that the principal origin of the salt in the Dead Sea was chiefly under or near to the sea itself. I feel then that it is to the river that we must ascribe the greater part of the vast accumulation.

How then does the analysis of the sea compare with that of the river? We find that the calcium, sulphate, and silica soon disappear for the most part after entering the Dead Sea, just as they did to a certain extent in the Sea of Galilee, and that they further decrease from north to south. This is evidently caused by the precipitation of $CaSO_4$ and $SiO_2$.

The $CO_2$ has also disappeared from the Dead Sea water. Some of this will have been precipitated as $CaCO_3$, but the free $CO_2$, of which there is bound to be some, must escape from the surface. This is no doubt the origin of the line of froth often seen down the longitudinal axis of the sea.

We find also, which is most important, that while in the Jordan water the proportion of sodium to magnesium is about 4 to 1, after entering the Dead Sea the proportion is reversed, ultimately becoming about 1 to 2. This reversal is due to the fact that sodium chloride, being so much less soluble than magnesium chloride, is precipitated first. Indeed, practically no magnesium chloride is precipitated, the salt being so soluble and hygroscopic; concentration to its crystallizing point would be impossible by solar heat alone. From this we gather that if the Jordan salts, as we have nearly proved, be the chief source of those in the Dead Sea, then for every part of sodium chloride remaining in solution, there must have crystallized out at the bottom at least five times as much. The exact relation of NaCl to $MgCl_2$ in the Jordan water is 353 to 146 parts, so that since we have shown that the Dead Sea contains $16{\cdot}1 \times 10^9$ tons of $MgCl_2$, it must also contain in solution and in solids at the bottom no less than $39 \times 10^9$ tons of NaCl.

Taken in round numbers we have in all:

| | |
|---|---|
| NaCl in solution ... ... ... ... ... | $6 \times 10^9$ tons. |
| NaCl in crystal at bottom and southern border ... | $32 \times 10^9$ ,, |
| $MgCl_2$ in solution ... ... ... ... ... | $16 \times 10^9$ ,, |

How long would it take, then, at the present rate of supply, for the river Jordan to deliver this amount of salt? To determine this I take the magnesium contents in each for comparison. Taking 1 gallon of Jordan water as containing 0·00037 lb. Mg and 6 million tons or 1344 million gallons per day as the flow, then 181 million lbs. per annum of Mg would be poured into the Dead Sea. The Dead Sea, as I have shown, contains $9{\cdot}1 \times 10^{12}$ lbs. of Mg. Hence, assuming the rate of flow and composition of the Jordan water has always been the same as at present, the time taken to supply the salts to the Dead Sea would be about 50,000 years.

The probability of course would be that the salt content in the Jordan

will be growing very gradually less as time goes on, but this can only be settled by comparing analyses over a lengthened period of time. A difficulty also arises owing to seasonal variations, but this may be partially surmounted by comparing the outflow from Galilee. Seeing that the life of the Dead Sea is probably short compared with that of the Jordan gorge, it is not likely that there has been any great change in the volume or composition of the river since it first began to form.

Then there is the question of the accuracy of figures for flow of the Jordan. I do not know who was the first to suggest 6 million tons as the daily average flow, but all writers on Palestine appear to accept it. McIntyre, geologist to the Palestine Exploration Fund, says it is at least 6 million tons. Now, taking Captain Lynch's figure 340 square miles as the area of the Dead Sea, it means an evaporation of 99 inches per annum plus any little actual rainfall into the sea. In this country the average evaporation amounts to 16 inches per annum.

It is very difficult to make an experiment on evaporation under conditions similar to those obtaining in the Dead Sea area, but I should say that the figure 99 inches is on the high side. The sample which I took from the north end does not evaporate at all in our climate until the temperature reaches 50° F. or more according to weather conditions. Below that temperature it absorbs water from the air. Further south the water would require a higher temperature still owing to its greater concentration. In our climate, even though it received no water from the rain or rivers, it would probably increase in volume, instead of diminish, by absorption of water from the air. Though 99 inches per annum appears such a high figure, I would not like to say it is impossible. Last summer I made some experiments with my sample placed in the sun while the temperature in the shade was 73° F., and obtained a higher evaporation than was needed to correspond with 99 inches per annum. The rainfall we know is practically nil and cloudy weather is infrequent. The average temperature I believe is 74° or 75° F., but of course the air pressure is high, and this has a considerable effect in retarding evaporation, as I have found with my sample. All I can say is, that I think the flow of the Jordan is probably less rather than greater than 6 million tons per day, and if this be so, and providing the composition has remained the same, 50,000 years would be the minimum time taken for the formation of the Dead Sea in its present condition. On the other hand there is also the possibility that the salinity of the Jordan is gradually becoming less, so until we have further evidence of its age I think we may regard 50,000 years as a fair estimate.

Assuming the bulk of the magnesium chloride to be provided by the Jordan, then at the present time the level of the lake must be rising at the rate of 1 foot in 125 years.* For the Jordan brings in 181 million

* Owing to the deposit of NaCl, $CaSO_4$, $CaCO_3$, and detritus brought down by the Jordan, the actual level of the sea will probably be raised as much again in that period.

pounds of magnesium chloride per annum, and if the solution is already concentrated to $MgCl_2$ and none crystallizes out, this requires an additional depth of water each year, which I calculate at 1/125 foot. This will be continuous, but apart from this there have been and probably are still cyclical variations, depending on rainfall and temperature. During the past thirty years there has been a rise of several feet in the level.

My general conclusion from these investigations is that the Jordan and Dead Sea together form a gigantic piece of natural apparatus for taking the mixed chlorides of magnesium and sodium from their home in the recesses of Mount Hermon and the hills further south, dissolving them and recrystallizing the sodium chloride in the enormous evaporating pan of the Dead Sea, leaving the magnesium chloride in solution.

It is evident from what I have said that this investigation is only half complete. To complete it properly I would like to have, and am hoping to obtain, samples from all the principal tributaries of the Jordan and the springs in the district.

Before the paper the PRESIDENT said: The paper this afternoon, by Mr. Wilfred Irwin, deals with the question of the composition of the Dead Sea. As we all know, the Dead Sea contains a very large amount of salt. I have been trying to visualize the amount which Mr. Irwin has concluded that it contains—an amount in figures, I think, of 39,000,000,000 tons—and in order to assist me to visualize that amount, Mr. Irwin tells me that it would form a solid mass 4 cubic miles in extent. One of the interesting features which Mr. Irwin will bring out in the course of his paper will be that the greater part, if not the whole, of this vast amount of material has been brought down by the Jordan river, and that the period of time which he estimates has been necessary for the river to bring down this salt is something like 50,000 years. He will give you many more details with regard to this matter, and I will ask him to read his paper.

*Mr. Irwin then read the paper printed above, and a discussion followed.*

Sir HENRY MCMAHON: I have had personal experience of another but less known case of a river system failing to reach the sea, *i.e.* in Seistan, on the borders of Afghanistan and Persia. As Mr. Irwin was giving his paper I jotted down one or two points of similarity and dissimilarity between those last two systems. In Seistan there is a lake which in flood-time is over 100 miles long and from 5 to 15 miles wide. Unlike the Dead Sea, it is not a deep lake. The lake in Seistan, which we call the Hamun-i-Seistan, has a depth of only some 3 to 15 feet, but covers an area very much larger than that of the Dead Sea. Into the Hamun-i-Seistan runs not one river, but four: the Helmund, the Kash, the Hari-Rud, and the Harut-Rud; the Helmund being by far the biggest of these four. Between them they drain very nearly the whole of Afghanistan. The Helmund is a large river; much bigger, I should think, than the Jordan. I do not know the cubic discharge of the Jordan, but the Helmund brings down in its lowest dry season about 2000 cubic feet per second, and in normal flood season something like 60,000 to 70,000 cubic feet per second. (We estimated the discharge of the abnormal flood of 1885 at some 600,000 cubic feet per second.) Salinity, of course, depends largely on two

factors: the nature of the water that comes down in the rivers, and the coefficient of evaporation, which again depends on the temperature and dryness of the air in that locality. Mr. Irwin has said that the evaporation in the Dead Sea is 99 inches in the year, and he questioned whether that was not too high. In Seistan, where we made careful tests, we found the evaporation was even greater; it was 120 inches in the year. If we get that coefficient in Seistan I do not see why we should not get one of 99 inches in the Dead Sea, the Dead Sea being such a very hot and dry area. So also is Seistan, but the latter has something else which assists evaporation, namely, a continuous strong and very dry wind. In both countries the rainfall is practically nil.

To return to the Hamun-i-Seistan. With that enormous evaporation in a shallow lake, you would imagine that you would get very salt water. Fortunately, this was not the case, because my camp and I were dependent upon it for long periods at a time. It was all the water we had to drink, and it was by no means bad. What is the reason for this peculiar difference between the two lakes? About every ten years, when there is an exceptionally big flood down the Helmund and the other rivers into Seistan, the Hamun-i-Seistan overflows and flushes itself through a dry channel called the Shelag into another lake about 40 miles further on called the God-i-Zirreh. As far as I know, only some six Englishmen have ever seen that lake, and I strongly advise others not to go out of their way to do so. There the water is concentrated brine; far salter than the water of the Dead Sea. It is so salt that no birds will go near it—and I understand waterfowl do go to the Dead Sea; no fish of any kind are to be found in it, whilst, as you know, there are a fair quantity of fish especially in the northern portion of the Dead Sea.

I am not a chemist, and I had no chemist with me to measure the salinity of the God-i-Zirreh, but I put it to a simple and practical test. It was while engaged on the demarcation of the Indo-Afghan boundary in 1895 that I first came upon this God-i-Zirreh lake, and I found it a large area of dark, deep blue water surrounded by a fringe of pure crystals of white salt extending for hundreds of yards wide round the brink. It was in the middle of a hot summer, and summer in that part of the world can be very hot. We had been working through a waterless desert for several weeks, and we had great difficulty in getting sufficient water to drink and could spare little or none for washing. On finding ourselves so near a wide expanse of beautiful blue water the natural temptation was to bathe. I shall never forget that simple practical test of salinity. It was no laughing matter, for I had to take to my bed, and was there for two or three days with very high fever and in extreme pain. I could not tell you exactly how much chlorine or sodium that water contains, but as a comparative test it was sufficiently accurate to prove convincingly that the God-i-Zirreh water is much salter than the Dead Sea, where it is possible to bathe without painful results.

It was to me and to all with me during our time in Seistan, a source of constant wonder why there should be such a difference between the Hamun-i-Seistan and the God-i-Zirreh.

Mr. R. I. MONEY: I was interested in what the lecturer said about magnesium and calcium having been extracted from Mount Lebanon, because a feature of some of the rivers rising on that mountain is that after flowing in a channel on the surface for some distance they entirely disappear down fissures in the limestone rock. Nearer the sea-coast are large caves and caverns from which streams of water flow out. These fissures and caves are doubtless formed by solution of the chemicals in the limestone. A well-known example

is that of the Nahr el Kelb, or Dog River, which bursts out in great volume from a large cavern situated 1½ miles from the sea. This is the source whence Beirut draws its supply. In this cavern is an underground river, up which you can go in a boat for some distance, and when you leave the boat, by swimming and wading you can go still further.

In this connection we had a curious experience when laying on a water supply to some villages in the Kesruan District of the Lebanon. Our source was situated high up on the slopes of the mountain, which we tapped at a point some 12 miles distant from the Nahr el Kelb cave. The stream ran a further 7 miles after we tapped it, and then entirely disappeared down fissures in the rock. Complaint was made that we were drawing off water from the Beirut supply. We did not agree, and said that the water from our source after flowing underground came to the surface in the sea out in the Bay of Junie 5 miles distant from the Nahr el Kelb. Unable to convince the complainants, we arranged to carry out a test. Red aniline dye was poured into the stream shortly before it disappeared down the crevices in the rock, and we said if this is a source of your supply the red colour will appear in the Dog River Cave. At the same time that this was done watchmen were posted in the cave to report directly the dye appeared. After some days, no discoloration of the water appearing, the watchmen were removed. It was a curious coincidence that as soon as the watchmen were removed our opponents announced that the dye had appeared in the cave.

As regards the important question of evaporation, I do not propose to say anything on the scientific side, but I would like to refer to the experience of a bathe in the Dead Sea. It has not been referred to to-day. The first time I went in and tried to get down to the bottom, though only a few yards from the shore, I found it impossible: while floating on the surface the greater part of the body was out of the water. On coming out, having no towel, after standing in the open for a few seconds, the body was sufficiently dry to put on my clothes, but riding back to Jericho was very uncomfortable because the salts left behind from the evaporation were sticking to my body and produced an irritation. On the next visit I took the precaution of carrying a little fresh water with me, and on coming out of the Dead Sea instantly washed all the salts off. On the ride back to Jericho, instead of feeling fatigued and tired as one had previously done, there was an extraordinary feeling of exhilaration and fitness, which was afterwards explained to me as due to the magnesian salts in the Dead Sea.

Mr. H. SEFTON-JONES: If I may venture to offer a remark as a visitor to-day, I should like to add that there is a third element in waters of this kind which has not been mentioned, and that is the possibility of subterranean springs. We know that the Dead Sea has always been known as the bitumen lake. I do not speak from knowledge of it myself, but I conclude that there are subterranean springs there. Some years ago I traversed the Syr-Daria valley in Turkestan, and there there is a series of lakes, some of them mere ponds, some of them quite large lakes, in what is now practically desert. Many of them are very saline, and you can tell them at once, for, as has been mentioned, the wildfowl never settle on them. Others are fresh and probably of recent formation. Then there is another set of hot springs and hot lakes which are evidently of volcanic origin. That circumstance persists right away through to the great lake Issik Kul itself, which, as you know, is named the salt lake from the fact that the salt springs are in it, or in parts of it. I think that should be taken into account when endeavouring to explain the salinity of the Dead Sea.

Mr. HINKS: I should like to ask Sir Henry McMahon whether or not there is any growth of vegetation round the Hamun-i-Seistan.

Sir HENRY MCMAHON: There are dense beds of reeds and bulrushes round the larger portion of it extending in places to some miles in width. But in the other lake, the God-i-Zirreh, there is no vegetation of any kind within miles of it.

Mr. HINKS: I asked the question because in the *Journal* rather recently there was a paper on lake Chad, in which the question was discussed why that lake, which is a basin of internal drainage, does not get salt. The paper, which was by an agricultural expert of Nigeria, maintained that the annual growth of vegetation on the banks of lake Chad would take away enough salt to account for the fact that the water remained comparatively fresh. I understand that it is quite possible that similarly the very rank growth of vegetation around the south shores of the Caspian may account for the fact that that sea is relatively fresh, although it takes the whole immense water of the Volga. That seems, then, to be an alternative possibility, which I would like to suggest to Sir Henry, for comparison with his ingenious explanation of the flushing out of the lake every ten years or so.

Before I sit down perhaps I may say that it was a considerable pleasure to me to put Mr. Philby, who is Adviser to the Emir of Transjordan, into communication with Mr. Irwin some few months ago. Mr. Philby took a great interest in Mr. Irwin's paper when first submitted to us, and has promised to use every effort to get samples of the water from the Jordan at as many places as possible, and at as many different seasons. We hope that there will be a great many more of those nice little bottles containing samples coming back to Mr. Irwin, so that in a future year another paper of his may bristle with statistics.

Mr. WILFRED IRWIN: I feel extremely indebted to you for the very kind way in which you have listened to this paper. I thought it would have been too dry for most people outside the chemical world to wish to spend an hour or so listening to and discussing it. Its preparation has been of very great interest to me, and I hope with Mr. Hinks' and Mr. Philby's assistance, and possibly another visit to the area myself, that in some future time I may be able to give a much fuller account of the subject than I have been able to present to you to-day.

In regard to evaporation, I said I thought 99 inches was high. Had it been pure or drinkable water, 99 inches would not have been high; but a large proportion of the Dead Sea is water containing 20 to 25 per cent. of salts which are hygroscopic. That was my reason for rather doubting whether 99 inches would be considered a correct figure. I have made experiments with the water from the north of the Dead Sea, and there I can get over 99 inches at the average temperature. Further south it is more dense, so more experiments are required to find out whether it is a possibility or not.

Then as to the possibility of the Dead Sea salinity being due to submarine springs, we have to remember that at one time in its existence the whole Jordan valley was a fresh-water lake, and I do not think it is probable that those salt springs would have been under the level of the Dead Sea any more than they were at other parts of the Jordan valley. I would say that the probability is that although there might be some salt due to such springs, still the bulk of it I do not think would be, especially as such a large proportion now comes all the way from the Waters of Merom, down to the entrance into the Dead Sea, with a concentration of only about 25 per cent.

With regard to the lake in Persia, the evaporation of 120 inches a year for ten years would not be sufficient to materially alter the salinity, provided at the outset it were only that of an uncontaminated English river. As to the fish in the Dead Sea, they are found only just at the mouth of the Jordan.

The PRESIDENT: We have had a very interesting paper and discussion. The picture which the lecturer seems to have painted of the country which has been described this afternoon is that of a great natural laboratory with the Jordan and the Dead Sea as the apparatus; the Jordan for bringing the sodium and magnesium chlorides down from the mountains of Lebanon, and the Dead Sea the great pan from which the salt is reproduced in solid form, the magnesium chloride, I understand, being mostly kept in solution.

I hope that Mr. Philby will find it possible to send back to this country samples of water from different localities in the neighbourhood, which will enable Mr. Irwin to carry on the investigations which he has been undertaking in connection with this question. We are most grateful to him, I am sure, for the painstaking way in which he has brought together a great mass of material, and for the careful analysis which he has made of it. I venture to express to him, on your behalf, our profound thanks for the trouble which he has taken in putting this matter before us this afternoon.

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## THE FUTURE OF INTERNATIONAL CONGRESSES

IN the old days before the War there was some danger that a multiplication of Scientific Congresses might defeat their own object, which was to secure that a man's scientific work should be stimulated and assisted by intercourse with other workers of like interests. Congresses tended to become so numerous and so numerously attended: the social functions arising from them were so many and elaborate, that a serious man was apt to return from a week of congress with the feeling that he had not had any opportunity to talk with the people he would have liked to meet, on the subjects which he would have preferred to discuss. The hosts, on the other hand, were compelled sometimes to feel that they had spent a good deal of money on the reception of a congress too large for any serious work, in a series of entertainments which effectually prevented it. This was of course not universally true. Some congresses did much more work than others; but always the cost of entertainment bore heavily on the country or city or society which issued the invitation.

By the Treaty of Versailles the permanent conventions for international scientific co-operation were abrogated, except a select few, such as the Metric Convention. This was the death of some notable bodies, as the *Comité permanent pour l'exécution de la Carte du Ciel*. Other bodies, as the International Geodetic Association, were governed by conventions renewable at dates between 1914 and 1918, which in the circumstances could not be renewed; they were already dead in 1919. Others again, as the International Geographical Congress, had a somewhat loose constitution by which the organization of any congress

was committed to an executive committee formed by the country whose invitation had been accepted by the preceding congress. Thus at Rome in 1913 an invitation to Petrograd was accepted for 1916, and the Italian Executive Committee of the Rome Congress handed over its powers to the Petrograd Committee.

Towards the end of the war the principal Allied Powers decided for an International Research Council, with headquarters in Brussels, to replace the old International Association of Academies—another victim of the war—and one of the duties of this Council was to promote the formation of International Unions in the various sciences. The Allied and Associated Powers were invited to adhere to this Council, and almost all did so. At a rather later date the Neutral Powers were invited to come in, and all the principal neutral states accepted the invitation.

At the second meeting of the International Research Council held in Brussels last July, it was resolved to form an International Geographical Union: statutes were approved and submitted for ratification to the adhering nations (see *Geogr. Jour.*, vol. lx. 291, Oct. 1922). At the same Council the Kingdom of Egypt was invited to adhere to the International Research Council.

With this summary of events in mind we may examine a somewhat delicate question raised by an invitation to attend the "Eleventh International Congress of Geography and Ethnology" at Cairo in 1925, under the august patronage of His Majesty King Fuad the First. It is important to observe precisely the growth of this proposal in swiftly changing circumstances.

In February 1922 the High Commissioner for Egypt transmitted a "Note" handed to him by the A.D.C. to his Highness the Sultan. It opened thus:—

"The Sultanian Geographical Society founded on 19 May 1875 in virtue of the decree of H.H. Khedive Ismail Pasha, proposes to commemorate the 50th anniversary in the course of the year 1925 by the holding of an International Congress.

"The important rôle which the Sultanian Geographical Society had played in the history of the exploration of Africa has amply justified its creation and fully borne out the great prospects it held out to the learned world at the time of its inception, and the future congress should form an appropriate occasion for rendering homage and admiration worthy of the great work it has rendered civilization in the penetration and opening-up of the Dark Continent. Egypt was the first step, and it was through Egypt that the world got to hear the first news of the greatest discoveries. . . . The Sultanian Geographical Society of Cairo therefore deems it a point of honour to bring the foregoing to the notice of all learned societies interested in African problems and matters."

At this time Egypt was a British Protectorate, but very shortly

afterwards became an independent Kingdom, and the Sultan became King Fuad.

The President and Council R.G.S. replied through the High Commissioner, wishing the meeting success and hoping that it might be possible at a later date to nominate representatives to congratulate the Sultanieh Society on the attainment of its Jubilee.

Toward the end of May 1922 a circular was received headed " Commission Executive du X$^{ème}$ Congrès International de Géographie (Rome, 1913). Session extraordinaire." It set out that the Executive Committee had assembled in special session and had decided to resume the powers transferred to the Organizing Committee at Petrograd in 1915 until it was again in position to transfer them to an Organizing Committee of the XIth Congress able to act; that the Sultanieh Geographical Society had asked the privilege of calling the next International Geographical Congress at Cairo in 1925; that this request had been granted; and that Cairo being declared the seat of the International Geographical Congress of 1925, the above-mentioned Society was invited to form an organizing committee. The official languages of the Congress would be German, English, French, and Italian. The circular was dated 30 April 1922 and signed by Commandant Roncagli as General Secretary of the Executive Committee.

This action of Commandant Roncagli was at once challenged, for it seemed inconsistent with the adhesion of Italy to the International Research Council, which had declared the Constitution of the old Congress abrogated, and had under consideration a proposed International Geographical Union, since formed. Commandant Roncagli disclaimed all knowledge of this last, but would not give the names of the Executive Committee that had resumed and again delegated the ostensible powers to summon the old International Congress. It became evident on further inquiry that his action was repudiated by leading Italian geographers. And one may reasonably take the view that when the Cairo Society begged leave to call the XIth Congress, after the " pourparlers " admitted in the Roncagli circular, the Cairo Society was the innocent victim of a manœuvre.

However that may be, an Organizing Committee was formed in Egypt, and in its Circular No. 1 signed by Cattaui Bey, Secretary of the Committee and of the Royal Geographical Society of Egypt, we are told that " in accordance with the decision taken by the Executive Commission of the International Geographical Congress at their tenth session held in Rome on 30 April 1922, the eleventh session will be held in Cairo in 1925 under the designation The International Geographical and Ethnological Congress."

It is impossible for any country adhering to the International Research Council to admit the validity of the succession assumed in this announcement. The old International Congress was a victim of the war. A

new organization—the International Geographical Union—has been formed to replace it. We cannot now admit that the remains of a Committee surviving from 1913—Commandant Roncagli and others if any whose names cannot be ascertained—should be allowed to reassume powers which have lapsed, and reconstitute a Congress which has been declared dead by the official representatives of Italy acting with the other Allied Powers.

The Kingdom of Egypt itself has been cordially invited to adhere to the International Research Council, but finds itself in the embarrassing position that it has issued invitations which cannot be accepted by any of the geographers who have put their hands to the new international organizations of science. These geographers would all wish to join in celebrating the Jubilee of a Society which has done good work in the past, and will in the new political conditions have brilliant opportunities for the future. But the proposed Congress, calling itself the Eleventh International Congress and claiming legitimate descent from the pre-war Tenth, is quite another matter. We are bound by loyalty to the International Research Council to maintain that the old line ended with the tenth, and that there can be no direct succession.

The duty of organizing geographical congresses—as distinct from festivals such as the celebration of centenaries or jubilees—rests now with the International Geographical Union, formed at Brussels last July. The Union is expected to meet every three years, and its first meeting was fixed for the spring of next year. It would be natural though not inevitable that a congress should be held at the same time and place: the executive Committee, formed of the President, the six Vice-Presidents, and the General Secretary, will therefore soon be considering the lines upon which to organize.

We have already suggested (*Geogr. Jour., loc. cit.*) that in present conditions no serious expense must fall upon the country issuing the invitation: it should be understood at the start that there will be no banquets, receptions, gala performances at the Opera, or other costly impediments to work. The meeting might be held in a University town, or a quiet health resort, or in any pleasant place with comfortable but simple accommodation, and a sufficiency of meeting-rooms that could be borrowed or hired. The funds of the Union should suffice for the small expenses of hire and administration: perhaps attendants at the Congress other than official delegates to the Union should pay a small subscription; printing and papers should be spared as much as possible; and there should be plenty of leisure for informal discussion and cultivation of scientific friendship in a quiet and pleasant place. Such a Congress would not attract a crowd, and would be all the better for that; but if it did not attract the right kind of serious geographers, then perhaps for the present international congresses are better left uncalled.

## LOT'S WIFE ROCK, ST. HELENA

Lieut.-Col. W. H. Turton, late R.E.

WHEN I was stationed at St. Helena I used to explore out-of-the-way parts of the island, looking for fossil shells and minerals. One day (13 March 1884) I discovered by accident a very remarkable view of the large rock called Lot's Wife. It is marked on the map as 1550 feet above sea-level, and stands at the bend of a sharp ridge, slightly rising behind, and sloping down steeply in front. My view was from an uninhabited part of the island, about three-quarters of a mile north-east, and in exact prolongation of this ridge, which is consequently hidden by the rock itself. It thus apparently stands on the top of a hill. It is this, combined with the enormous size of the rock, that makes the view so impressive.

A photograph made at the time with a small camera was disappointing, and I always hoped some day to get a picture that would do justice to such a striking view. In 1920 I was glad to hear there was a good photographer on the island—Mr. Broadway. I therefore sent him a tracing of the map, and my old photograph as a guide to the right position. And when he had found this (not an easy matter), I instructed him to have several men put out at intervals of a few hundred yards, with a bell-tent in the distance near the rock, hoping in this way to give some idea as to its size. But the tent was placed at least half a mile from the rock, as it would have been scarcely visible much nearer, and so it still afforded no scale of measurement.

I then sent a tele-photo lens out from England, and with this Mr. Broadway obtained (8 December 1922) a very good photo. In accordance with my instructions he placed a man dressed in white (5 feet 6½ inches high) in front of the rock, and another dressed in black (5 feet 8 inches high) against the skyline to the left.

Calculating from these men, and allowing for the top being some distance further than the man in white, and nearly in line with the man in black, the height of the rock would be about 300 feet. This is a little more than that given by Mr. Grant in his 'Guide to St. Helena' (270 feet), and a good deal less than I estimated it at myself (about 370 feet), but my methods were very rough, and I never placed much reliance on them. The rock seems to be a large mass of lava forced up through some fissure near the crater of the volcano, and exposed by denudation. There is a similar rock, though not striking, called Lot, about 1½ miles distant.

1. LOT'S WIFE ROCK, FROM THE EAST, NEAR SANDY BAY

2. LOT'S WIFE ROCK, ST. HELENA, FROM A POINT ABOUT THREE QUARTERS OF A MILE N.E. OF THE ROCK, AND THE SAME DISTANCE W.N.W. OF SANDY BAY, ON THE SOUTH COAST

3. LOT'S WIFE ROCK, ST. HELENA

The rock photographed from the same point as No. 2, with tele-photo lens. There is one man in white standing below the rock and in front: the second, on the skyline below the rock to the left, has been lost in reproduction.

# THE RUSSO-TURKISH BOUNDARY AND THE TERRITORY OF NAKHCHIVAN

Lieut.-Col. J. H. M. Cornwall

[*Note: We are much indebted to Colonel Cornwall for these corrections to an article based on an incomplete and erroneous, though official (but not British) version of the Russo-Turkish treaty of Moscow, 1921, sent us by a correspondent.*—ED. *G.J.*]

AN article, entitled "The Russo-Turkish Boundary of 1921," which appeared in the *Geographical Journal* for March 1923, contained two serious errors:

1. Incorrect alignment of the new Russo-Turkish boundary in the sector between the rivers Qura and Arpa Chai; the boundary shown in the upper sketch-map on p. 210 of the *Journal* is drawn too far east in this sector, a particularly important one as it comprises the portion of the frontier crossed by the Kars–Aleksandropol railway.*
2. An erroneous interpretation of Article 3 of the Russo-Turkish Treaty, leading to an entirely false idea of the "Territory of Nakhchivan." The small triangular area shown in the lower sketch-map on p. 210 does not represent the whole "Territory of Nakhchivan," but only a small corner of its north-western extremity in which, at the time of signature of the Moscow Treaty, the exact trace of the frontier between Armenia and Azerbaijan in the Araks valley had not yet been decided. This is clear from the correct translation of Article 3 of the Russo-Turkish Treaty which I enclose.

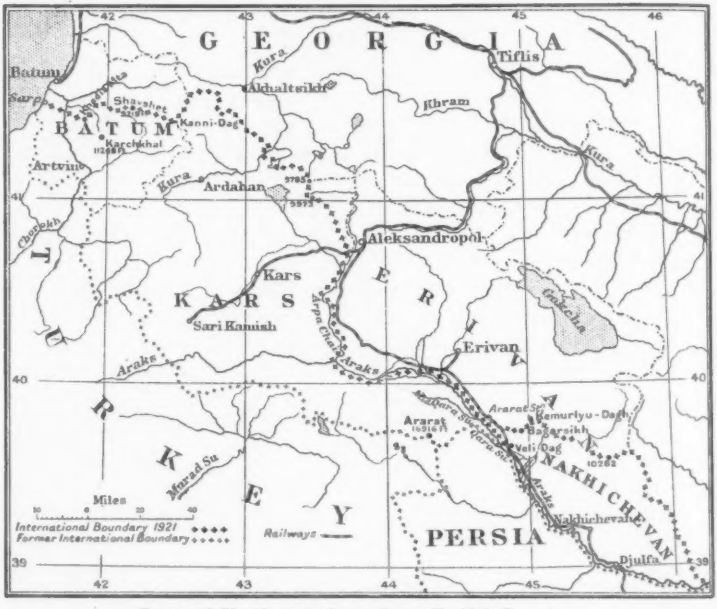
It must be remembered however that the Russo-Turkish Treaty, signed at Moscow on 16 March 1921, was modified by the very important Treaty of Kars, which was signed on 13 October 1921, between the Grand National Assembly of Turkey and the Socialist Soviet Republics of Armenia, Azerbaijan, and Georgia. The Russian Soviet Government was also represented, and Hanetski, the Moscow delegate, attached his signature to the Treaty of Kars.

The Treaty of Kars ratified generally the provisions of the Moscow Treaty, repeating almost word for word the Territorial Clauses regarding the north-eastern boundary of Turkey. The Treaty of Kars reaffirmed the establishment of the autonomous Territory of Nakhchivan (under the sovereignty of Azerbaijan), and definitely delimited its boundaries, a small portion of which had been left undecided by the Moscow Treaty.

* *Editor's note:* There was also incorrect alignment in the section Khedis-mta to Shavshet. The appendix shows that the line cuts across instead of going round by the high peak Karchkal.

I have before me the Turkish text of both treaties, as officially published by the Grand National Assembly of Turkey; since so much doubt has arisen regarding the trace of the various boundaries concerned, I have translated in full the territorial clauses and appendices of both treaties.

As regards the spelling of names, I have transliterated the Turkish version according to the R.G.S. II. System, following suit when the Turkish edition gives in brackets an attempted transliteration of the Russian map names.* As an exception I have adhered to the commonly




Corrected Sketch-map of new Russo-Turkish Boundary.

accepted spelling of Kars. In the Turkish text of the two treaties the same name is on several occasions spelt differently.

I hope that this information will finally dispel all doubts about the north-eastern frontier of Turkey and also about the autonomous Territory of Nakhchivan. This latter territory stretches for some 110 miles along the left bank of the Aras (Araks) from east of Mount Ararat to a

* *Editor's note:* But the result of thus transliterating Turkish versions of Russian is often unsatisfactory, as in "Bul Ag Baba." Bul Ag is not a misprint for the Turkish Bulag, but Bul represents the Turkish for Russian Bol., the abbreviation for Bolshoi = great. We have also curious hybrids, as Qioraliski. The names on the corrected sketch-map are transliterated from the Russian 1/210,000, some being thus from Russian versions of Turkish.

point 35 miles east of Julfa. The territory is some 36 miles wide in the middle, and tapers to a point at its north-western and south-eastern extremities.

From a geographical point of view the treaties between Turkey, Russia, and the small Trans-Caucasian States are of great interest. The Turkish and Caucasian treaty-makers have succeeded in defining international boundaries across one of the wildest and most mountainous tracts of country in the world. They appeared to have shared the penchant of their prototypes at Paris for "talwegs" and watersheds, but were probably right in showing a preference for well-marked physical features in a region where populations are sparse, and international rights have to be enforced by rough-and-ready methods. The trace of the Turkish frontier south of Batum and west of Aleksandropol is particularly interesting, as it shows that an attempt has been made to reconcile the strategic claims of a strong Turkey with the economic entity of the border communities.

The other international treaties published by the Grand National Assembly of Turkey are the Turco-Afghan Treaty signed at Moscow on 1 March 1921, *i.e.* a fortnight before the Russo-Turkish Treaty, and the Turco-Ukrainian Treaty signed at Angora on 2 January 1922. In the first of these the Turkish and Afghan Governments agreed to recognize the independence of the States of Bokhara and Khiva, while in the latter treaty the Ukrainian Government accepted all the territorial clauses of the Russo-Turkish Treaty and the Treaty of Kars.

## RUSSO-TURKISH TREATY OF 16 MARCH 1921

### *Extract from Article* 1.

The north-eastern boundary of Turkey begins at the village of Sarp, situated on the Black Sea, and is defined by the line Khedis Meta Dagh—watershed of Shavshet Dagh—passing Qani Dagh—from there continuing along the northern administrative boundary of the sanjaqs of Ardahan and Kars—following the "talweg" of the Arpa Chai and Aras and reaching the mouth of the Lower Qara Su.

For the details of the boundary and for matters relating thereto, see Appendices 1 (*a*) and 1 (*b*) and the map signed by both contracting parties.

### *Article* 3.

The two contracting parties have agreed that the Nakhchivan Area, within the boundaries defined and delimited in the explanatory appendix (*c*) of this treaty, shall form an autonomous territory under the protection of Azerbaijan, on condition that this protectorate right is never surrendered to a third power.

In the triangular area situated east of the "talweg" of the Aras and bounded by the line: Daghna Dagh (3829)—Veli Dagh (4121)—Baghirsiq (6587)—Kumurlu Dagh (6930):

That portion of the boundary of the Territory of Nakhchivan which begins at Kumurlu Dagh (6920), and runs through Serai Bulaq (8071) and Ararat Station, and ends at the point where the Qara Su flows into the Aras, will be

rectified by a technical commission composed of representatives of Turkey, Azerbaijan, and Armenia.*

*Russo-Turkish Treaty. Appendix* 1 (*a*).

The North-Eastern Boundary of Turkey is defined as follows (*Ref.* Russian General Staff Map 1/210,000 (1 inch to 5 versts):

The village of Sarp (Sarpe) on the Black Sea coast—Qara Shalvar (Kara Shalvar) Dagh (5014) and crossing the Chorokh to the north of the village of Mardidi (*v.* Maradidi)—North of the village of Sabaor—Khediz Meta Dagh (7052)—Qva Kibe (Kva Kibe) Dagh—Qavtareti (Kavtareti) village—the watershed of Medizibna Dagh—Gerat Kesun Dagh (6468)—following the watershed of Qorda (Korda) Dagh (7910), passing the west part of the crest of Kharabet Shavsa Teski Dagh it reaches the former administrative boundary of the old Artvin qaza—passing the watershed of Shavsha Teski Dagh it reaches Sari Chai Dagh (Qara Issali) (8478)—Qioraliski Col, and from there along the administrative boundary of the old Ardahan qaza to Qanni Dagh.

From there it turns northwards as far as Elil (Garmani) Dagh (8357)—following the same Ardahan boundary-line, and reaches the Posqov Chai, north-east of Badela village, and follows this river due south as far as the north of Chanjaq village. There it leaves this river and follows the watershed as far as Erilian Bashi (Airrilian Bachi) (8512). It passes the mountains Kel Tepe (8463) and Kharman Tepe (9709) to Qasris Seri (Karris Seri) Dagh (9681).

From there it follows the Qarzamet Chai as far as the Qura River.

Then following the "talweg" of the Qura River until east of Qartanakev village, and there passing the watershed of Qara Oghlu Dagh (7259) it leaves the aforesaid river.

Then a line bisecting Lake Qazapin to Point 7580 and thence reaches Geuk Dagh (9152)—"Three Hills" (9783)—Taya Qale (9716) to Point 9065, where it leaves the old Ardahan boundary-line.

Passing Biyuk Aq Baba (9973) Mountains. Points 8828, 8827, 7062, east of Ibish village, to Point 7518. Then to Qizil Tash—7439—7490—Novi Qizil Tash village, passing west of Qara Mehmed, reaches the Jamushbu Chai.†

Following the above-mentioned river by the villages of Vartanli and Bash Shura Gel (situated east of Delaver, B. Qamli and Tihsini (Tikhnis) villages), reaches the Arpa Chai River to the north of Qaleli (Kialala).

Thence continuing to follow the "talweg" of the Arpa Chai to the Aras; follows the "talweg" of the Aras to the mouth of the Lower Qara Su.

(*Note.*—It is here agreed that the boundary follows the watershed line of the above-mentioned heights.)

*Russo-Turkish Treaty. Appendix* 1 (*c*).

THE TERRITORY OF NAKHCHIVAN

Ararat Station—Serai Bulaq Dagh (8071)—Kemurlu (Kemoulu) Dagh (8839, 8930,‡ and 3080)—Sayat Dagh (7868)—Qurt Qulaq (Kourt Koulak) village—Gamesur Dagh (8160)—Point 8022—Kuki Dagh (10,282) and the old eastern administrative boundary of the Nakhchivan qaza.

* *Translator's note:* For final rectification of this boundary, see Appendix 3 of the Treaty of Kars.

† The name Jamushbu Chai is not shown in the 1889 edition.

‡ *Editor's note:* 6930 in Russian 1/210,000 map.

TREATY OF KARS, 13 OCTOBER 1921

*Appendix.* 1.

Sarp village on the Black Sea Coast to v.u. north of Maradidi village—along the watershed of Qara Shalvar Dagh (5014) and crossing the river Chorokh north of Maradidi village. From there north of Sapaor village—Kediz Meta Dagh (7052), Qva Kibe Dagh—Qavtareti village—the watershed of Medizibna Dagh—Gerat Kesun Dagh (6468)—following the watershed of Qorda Dagh (7910), and reaches the former administrative boundary of the old Artvin qaza on the west slope of Shavsheteski Dagh.

By the watershed of the Shavshateski Dagh and Sari Chai to Qara Issali Dagh (8478). Qioraliski Pass—thence to Qanni Dagh along the former administrative boundary of the old Ardahan qaza.

Thence turning north to Telil (Garmani) Dagh (8308). Following the same boundary of Ardahan qaza, to the Posqof Chai, north-east of Badel village, and follows this river due south to the hill of Chanjaq village.

Thence leaving this river it follows the watershed and reaches Edilian Bashi Dagh (8512).

Past the mountains of Kelle Tepe (8463) and Kharman Tepe (9709) to Qasris Serai Dagh (9681).

Thence as far as the Qura River it follows the Qalasamet Chai. Thence following the " talweg " of the Qura River to east of the village of Qartanake.

Thence passing the watershed of Qara Oghlu Dagh (7259) it leaves the Qura River.

Thence bisecting Qozapin Lake to the hill marked 7580 and 7560, and thence reaching Geuk Dagh (9152). Thence to " Three Hills " (9783) where the Georgian boundary ends and the Armenian boundary begins.

Taba Qale (9716) to the peak marked 9065, and there, leaving the old boundary of the Ardahan qaza, passes the mountains Bul Aq Baba (9973 or 9963) and 8828 or 8827 and 7602.

Thence in a straight line to the peak marked 7518, and then east of Ibish village, then by Qizil Tash Dagh (7439 or 7440 or 7490). Passing Novi Qizil Tash village.

Thence passing Qizil Tash, as far as the river bend situated north-west of Qara Mehmed, and following the watershed to the Jamush Bu Chai River,* which is to the east of the villages of Delavers, B. Kimli, Vitknis.

Continuing to follow the above-mentioned river by the villages of Vartanl and Bash Chura Gel, reaches the Arba Chai north of Kialala (or Qaleli).

Thence continuing to follow the " talweg " of the Arpa Chai, it reaches the Aras.

Thence following the " talweg " of the Aras as far as the village of Urmiya, where the boundary of Armenia ends and that of Azerbaijan begins.

Then it follows the " talweg " of the Aras to the mouth of the Lower Qara Su where the Azerbaijan boundary ends.†

(*Note.*—It is here agreed that the boundary follows the watershed of the heights described above.)

*Treaty of Kars. Appendix* 3.

NAKHCHIVAN TERRITORY

Urmiya village—thence in a straight line to Arazdayan Station (this station will remain to the Socialist Republic of Armenia). Then in a straight line to

* The Jamush Bu Chai is not named on the 1889 edition of the map.

† *Translator's footnote:* The last sentence obviously means " where the boundary of Turkey with Azerbaijan ends."

West Tash Burun Dagh (3142)—along the watershed to East Tash Burun Dagh (4108)—crosses the Jehennem valley, following the watershed of Bagharsik Dagh (6607 or 6587), and passes south of Rovne (Bulaq).

Thence following the former administrative boundary between Caucasian Erivan and "Sharur Valagoz" * by the mountain marked 6629 to Kumurlu Dagh (6839 or 6930), and thence to the mountain marked 3080,† to Sayat Dagh (7868) and to Kurd Qulaq village.

Gamsur Dagh (8160)—Mountain marked 8022 and Kuk Dagh (10,282) and the old eastern administrative boundary of the Nakhchivan qaza.

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## REVIEWS

### EUROPE

**The Stane Street. H. Belloc.**— London: Constable. 1913. *7s. 6d. net.*
**The Topography of Stane Street.**— **Captain W. A. Grant.** London: John Long. 1922. *5s. net.*

TEN years ago Mr. Belloc wrote a monograph on Stane Street which roused much interest in the Chichester–London *via* engineered by the Romans. His method was, apparently, to get together what had been written on the various sections; with the aid of 6-inch Ordnance maps to walk over the line of the road; as far as possible to see the remaining traces of Roman handiwork; and make detailed notes of his observations. He gave us a stimulating synthesis, though his pages are to some small extent marred by excessive pretensions to scientific accuracy and by unwarranted use of scientific terms. He used his maps, especially in contour work, very skilfully; and finally laid it down (somewhat dogmatically in places) that Stane Street consisted of four limbs—Chichester to Pulborough Bridge, thence to Leith Hill, thence to Juniper Hill, and so to old London Bridge. Between the terminals he posited four *mansiones*—Hardham, Alfoldean, Dorking, and Merton. The course of Stane Street is tolerably certain, with some conjectural stretches, between Chichester and Dorking, and from Merton Abbey to old London Bridge. The present reviewer has followed every yard of the line as laid down by Mr. Belloc from Chichester to Dorking (though no farther), the more conjectural and difficult parts of it many times, the least satisfactory being—as any one who knows the difficulties encountered among sandhills would expect—between Minnickwood farm and Dorking. At the end of last year Captain W. A. Grant published a critical review of the topographical work in Mr. Belloc's book, to correct "gross errors—in the interests of historical and archæological truth." It is with scientific topography only that he concerns himself; and indeed neither he nor Mr. Belloc is apparently an archæologist. The last word on the purpose and date of Stane Street, and in many cases also on its topography, will be with the diggers. If Captain Grant is a competent topographer, his pages give the impression that he has not walked over much of the line, and that he loses something by this deficiency. The methods of both Mr. Belloc and his critic are necessary. In spite of some asperity of verbal and minute criticism, Captain Grant does not improve matters materially so far as the Chichester–Dorking section is concerned, in which he would alter slightly Mr. Belloc's results. *The* crux is the course northward of Dorking, and here neither appears to be convincing, Mr. Belloc

* *Translator's note:* Evidently meant for the district of Sharur-Daralageuz.
† *Editor's note:* The spot-height 3080 is by a river on the Russian map.

taking the road on to the downs east of the gap, and Captain Grant taking it straight to Ashtead to join the ideal alignment from Chichester to London. In this discussion the question which inevitably arises, but which no one as yet can settle, is whether the Romans in planning a road had surveying instruments approaching ours in precision. Captain Grant seems to assume they had, whereas Mr. Belloc's hypothesis is that on the whole their methods were rough and ready. Captain Grant's book, in its turn, is not free from minor errors.

S. E. W.

**The English Village: the Origin and Decay of its Community: An Anthropological Interpretation.— Harold Peake.** London: Benn Brothers. 1922. *15s. net.*

To trace the character and life of the English village from prehistoric times to the present day, and to suggest an ideal village for the future, is the theme of this work. The author's imagination, stimulated by his anthropological studies, and the thorough knowledge, archæological and historical, of a countryside, enable him to sketch the conditions of rural life from the Bronze Age to the present time. That the descriptions of the earliest periods rest on meagre evidence he would probably be the first to admit, and the attribution of certain characteristics to Nordic or "Beaker" strain, though suggestive, can hardly be said to be demonstrated.

The village in Saxon, Norman, and Mediæval times, the rise and decay of the manor, the effects of the Agrarian Revolution and of Industrialism, are described in a sympathetic and interesting manner and should be found informing and valuable to every student of the social questions of the hour.

The suggestions for an ideal village, with which the book concludes, will probably appear almost utopian even to the most sanguine reformers, and to those who are most anxious to retain the people on the land. Yet there is nothing that seems beyond the capacity of sympathy, goodwill, and public spirit to realize.

The village of the future, if it is to play its full and proper part in our national life, must satisfy the social interests and desires of the people. It is the absence of such satisfying conditions that has made village life so deadening, and led to its abandonment by so many of the best sons of the soil. Let the village supply what the town can give in social life, and it may hold its own, with the added advantage of purer air and a healthier existence, to the benefit of the villagers and of England as a nation.

E. A. P.

## ASIA

**Lands of the Thunderbolt: Sikhim, Chumbi, and Bhutan.— The Earl of Ronaldshay.** London: Constable & Co. 1923. Pp. xviii. and 268. *Map and Illustrations.* *16s. net.*

This book deals with a region—Sikhim, Chumbi, and Bhutan—which for the grandeur of its scenery and the variety of its plant-life is unsurpassed by any in the world. And to these must be added the further interest of the sombre religion which the peoples who dwell there profess; while the writer, as Governor of Bengal, had for his summer residence a house situated in the very heart of the region he describes and from the grounds of which he could throw his eye over almost the whole. With such an inspiration to write, the wonder is that no previous Governor should have done what Lord Ronaldshay has done. At least we can hope that where he has led others may follow, for the interest of this wonderful region could never be exhausted.

The book is a narrative of travel, but it is also more. It is for a great

part a thoughtful, well-informed, and peculiarly sympathetic account of the particular form which Buddhism has taken among these strong-natured mountain peoples. This indeed is the chief value of the book; and from that point of view it is the most valuable that has so far been written. For Lord Ronaldshay sought and made opportunities for getting in touch with the leading lamas, and made full use of the opportunities he had created for himself. The result is that we get an insight into the inmost springs of the people's life. Other books have dealt more exhaustively with the detailed minutiæ of the ceremonials and creeds and of the lives of the saints. But none that the present writer knows has given us better the true spirit of the people. And it is this that all travellers and administrators must needs get hold of.

It is satisfactory to find that Lord Ronaldshay, whose experience of men is very varied, and whose opinion is therefore particularly well worth having, says that "there are among lamas and layman alike an attractive gentleness and kindliness of disposition, a dignified and courteous hospitality, and withal a cheerfulness and friendliness, which bear witness that the influence of an outstanding character and personality lives and works for good, unaffected by the flight of time."

There is not space for more than a reference to Lord Ronaldshay's account of his interviews with the leading lamas, but attention must also be drawn to the remarkably good photographs by the author himself of these lamas in their own surroundings. There is about them a certain rude strength which is decidedly impressive. And if the spirituality is not very refined, it is certainly there in considerable degree.

Of the journeys he describes perhaps the most interesting is that into Bhutan, and his descriptions, together with his fine photographs, leave us amazed at the wonders of Bhutanese architecture. Of the builders of one series of monastic edifices which seem to cling on to the very face of a precipice he says that they must be the most undaunted in the world. The riddle of the construction of these extraordinary buildings remains on a par with that of the pyramids at Gizeh. And he was overwhelmed with the immensity of the fort at Paro.

Another fascinating excursion he made was directed straight at Kangchenjunga itself. From his own headquarters at a height of 7000 feet above sea-level he could see this mighty mountain, 28,146 feet and only 40 miles distant, and he reached a pass only 7 miles from the summit. Standing there he reflected how easy it is to understand how such works of Nature impel man to worship. And later on he had a perhaps even more impressive sight, when from the Oma-la, 14,650 feet, he saw a panorama of snowy peaks covering an arc little short of 180 degrees, and extending from Mount Everest itself on the west through Kangchenjunga to the peaks of Bhutan.

Many other glorious views did he see and describe, and it is hard to refrain from referring to every single one. But enough has been said to indicate the richness of the ore this book contains, and readers must now dig for themselves. F. E. Y.

**La Syrie.— Dr. George-Samné.** Paris: Éditions Bossard. 1920. [1921 on cover.] Avec 30 photographies et 6 cartes hors texte. Pp. 729. 48 *fr.*

The intent of this ponderous volume, written when Syrian affairs were very much "in the melting pot," is obviously political and propagandist. It opens with a lengthy preface, dated August 1920, by Chekri Ganem, Président du

Comité Central Syrien, who was the moving spirit of the " mouvement Syrien," an organization very active during and at the close of the war, and whose doctrine, briefly stated, was " l'indépendance et unité de la Syrie." It presumes an autonomous and indivisible Syria stretching from the Taurus to the Isthmus of Suez and from the Mediterranean to the banks of the Euphrates and even beyond, and takes no regard of Palestine as a possible and separate political entity. As these expectations have not been realized, the book can hardly be said to deal with actualities, but nevertheless is worth perusing as stating a case from the Syrian standpoint.

There are chapters on the geography and history of Syria, the Turkish administration, agriculture and industries, commerce and communications, autonomous Lebanon, the provincial regime of the future, religions, the Sherifate of Mecca, Judaism and Zionism, Syria and Syrian effort during the war, Eastern nationalities and the lessons of the Great War, the " question Faycal " and Anglo-Indian intrigues, the French mandate, a suggested Syrian Constitution, together with various annexes and addenda. The earlier chapters are of most interest to the general reader, those treating of non-controversial questions such as past history, agriculture, religions, etc., being of considerable value; but, as facts and figures are based largely on Cuinet 1891 and 1896, trade figures are not more recent than 1913, and no statistics whatever are later than 1919, much of the matter of this part will be found out of date by the student of conditions in Syria in 1923.

In the later chapters, most English readers will join issue with the author who, if not altogether Anglophobe, shows a distinctly French partisanship. One would hardly gather that the British soldier had any part in freeing Syria from the Turkish yoke, though there is just a passing mention of " le plan Allenby." The following extract illustrates the author's viewpoint and attitude. He says: " Interrogez un Syrien, qu'il soit druse, musulman, maronite, juif, orthodoxe, catholique, qu'il soit de Beyrouth, d'Alep, de Damas, de Jérusalem; demandez lui ce qu'il veut pour son pays, il vous répondra: indépendance et unité de la Syrie, organization fédérative sur des bases démocratiques et laïques. Dans toutes les bouches, même réponse; dans tous les cœurs, souhaits identiques " (p. 523). It is to France that all Syrians look for help to this end (p. 599), whilst it is British perfidy in the East which, in the author's opinion (p. 661 *f.*), has prevented the realization of these aspirations.

References to authorities are carefully given throughout in the form of footnotes; but the book has no index. The numerous photographic illustrations, while good of their kind, have no particular bearing on the subject-matter. The maps are rather sketchy, but perhaps serve their purpose.

H. W. M.

**The Cambridge History of India.**— Edited by **E. J. Rapson, M.A.** Cambridge University Press. 1922. Vol. I. 42*s. net.*

This important work, which is to be completed in six volumes, follows the plan already adopted in the modern and mediæval histories from the same press, of dividing the authorship among specialists. The present volume deals with the history of ancient India from the earliest times to about the middle of the first century A.D. The early literature of India is singularly deficient in materials for its political history, and the climate, and war of a particularly ruthless character, have been hostile to the preservation of records of the past, even those embodied in metal and stone. The results here presented, which would have been regarded as unattainable a few years ago, are very largely due to the study of inscribed monuments and coins, and the thirty-four plates

illustrating coins and archæological remains are of great value and interest. The physical map of the Indian Empire provided is scarcely worthy of its place in the book, and it is bound in so tightly as to be unpleasant to consult. The highly coloured political map of modern India, crowded with names, which is placed in a pocket at the end of the volume, is of doubtful utility. A really good coloured orographical map, with the larger natural forest regions indicated, would have been much more useful.

Although the book is primarily one for historical students, it contains much of interest to those whose concern with India is more general. Some of the results arrived at correct or supplement statements made in the last edition of the 'Imperial Gazetteer of India.' Risley's use of the term "Dravidian" to indicate the original type of the inhabitants is misleading. The history of India is largely the story of the struggle between new-comers and the earlier inhabitants, and it seems probable that the original speakers of the Dravidian languages were themselves invaders who partly supplanted and partly mingled with the people who were there before them. These pre-Dravidian folk, now represented by the primitive tribes inhabiting the belt of hilly and jungly country between the Deccan and the northern plains, are among the most interesting peoples of India. Those of them who speak Munda languages, which are representatives of the Austric family of speech, the most widely diffused on earth, are probably really aboriginal. They are still governed by their primitive constitution, use the implements and weapons, and have the religious ideas and customs, of their remote ancestors of the Stone Age. As for the Indo-Aryan invaders, it is concluded on linguistic and geographical grounds that the original home of the speakers of the primitive Aryan language was the present Hungary, Austria, and Bohemia. Waves of migrations began probably not before 2500 B.C., at first of whole tribes, with women and children, flocks and herds, and later of armed expeditions. The change in the character of these invasions was probably due to the changes of climate over large tracts of Asia which have taken place within the historical period. The Indo-Aryan ethnological type is most perfectly preserved in the Punjab, Kashmir, and Rajputana, and the suddenness of the change to the Aryo-Dravidian type beyond a line a little to the west of Patiala and Umballa led to Hoernle's theory of a second Aryan invasion through Gilgit and Chitral. In the present work this view is not accepted. A natural and ethnographical boundary crosses the region of the divide between the Indus and Ganges river systems, near which so many of the decisive battles of India have been fought, and marks the eastern limit of Indo-Aryan tribal settlement, and the beginning of the Indo-Aryan colonization of the country occupied by Dravidians. On the vexed question of the origin of caste, which Risley regarded as insoluble, the view held is that the institution is essentially Brahmanical, and has spread with the spread of Brahmanism—a code which regards the family, not the congregation, as the religious unit. The first beginnings of caste were laid when the fairer-skinned immigrants felt the importance of preserving their own racial characteristics by holding aloof from the dark-skinned people whom they found already established, that is to say, in the period of Indo-Aryan colonization. The poets of the Rigveda knew nothing of caste in the later and stricter sense of the word.

This volume makes clear the intimate connection of the geography of India with its history. Geographical conditions controlled the distribution of races, and, in large measure, the development of civilization. For the historian a knowledge of the main features of surface relief and climate, and of the distribution of forest, desert, and cultivable land is essential, as well as some know-

ledge of the vagaries of rivers in the plains of India. Occasional large and numerous small changes of course, sometimes indicated by the names borne by the rivers or by sections of them, have taken place in historical times with momentous results. It is probable that the Jumna once flowed to the Indus and was the sacred Sarasvati of the Rigveda. Minor river changes have in many cases affected the value of town sites, and India is a country of deserted capitals.

The first chapter of this volume (contributed by an eminent geographer) gives in thirty-six pages a succinct account, in the form of an imaginary journey, of the geography of the India of to-day. The outstanding natural features and their influence are clearly brought out ; but in a popular description such as this there is inevitably a certain amount of matter that is not strictly relevant to the purpose of the book. There are also minor errors and statements of doubtful accuracy, some of which it may be useful to point out. Teak forest is not found in the Himalaya, nor do "trees of the fir tribe take the place of leafy trees" near Darjeeling. The trees found at that elevation are oak and other broad-leaved trees. Conifers begin above 9000 feet. Nepal is said to extend to "near Hardwar," and Mussoorie is stated to be the first hill station in the lower Himalaya west of Nepal. The first hill station on the British foothills of the western Himalaya is Naini Tal, some 100 miles east of Mussoorie. Sind is explained to be a part of the Bombay Presidency because "it is connected with Bombay by sea from the port of Karachi." This is not a happy example of causal geography. Karachi is the great wheat port of the Punjab, and the inclusion of Sind in the Bombay Presidency was due to the political conditions prevailing at the time of its annexation. When Sind was annexed the Punjab was still independent.

It is stated that the reason for the primitive character of the eastern Ghats region north of the Godavari "is to be found in the conditions of soil and climate," and that "there have been no volcanic outpourings on the gneissic and granitic rocks hereabouts, and the summer cyclones from the Bay of Bengal strike most frequently upon this coast." But other areas with similar soil are not primitive, and the summer cyclones do not strike more frequently on this coast than they do on the coast further north. The reason for the primitive character of the inhabitants of these forest-clad hill tracts is that they constitute a "Wales" into which the aboriginal peoples have been driven by the pressure upon them of more civilized races. The black cotton-soil of the Deccan is said to be due to the disintegration of the volcanic *trap* rock. It is true that large areas of this soil lie over trap, but considerable areas of it are also found in other parts of India overlying rocks that are not volcanic.

Finally, the description and explanation of the monsoon system are hardly in accordance with the results of recent observation and research.

W. H. A. W.

**In Lotus-Land Japan.— Herbert G. Ponting.** New and revised edition. London and Toronto: J. M. Dent & Sons. New York: E. P. Dutton & Co. 1922. *Illustrations.* 18*s. net.*

The outstanding feature in this book, now brought out in a new edition, is the wonderful series of photographs in which it abounds, and which cannot be too highly praised, though some of the coloured plates are less satisfactory. The excellence of the book considered as a collection of pictures must dispose us to look more leniently than otherwise on the defects which unfortunately lessen its value as a "guide-book for the traveller," the purpose for which, we are told, it is primarily intended. In spite of the author's statement that "the

text has been thoroughly revised" we still find many inaccuracies in statements of fact, besides numberless small mistakes in the spelling and in the use of Japanese words and the diacritical marks which have so important a bearing on both their pronunciation and their meaning. This is the more unfortunate because, as Mr. Ponting justly remarks (p. 61), "it is impossible for aliens who cannot speak Japanese to gain more than a superficial knowledge of the people."

The following are a few of the inaccuracies we have noted, taken at random. We are told that the "largest cherry-tree in Japan" is that at Kami-ide, described on p. 108, but there is a much finer and older one near Hinobaru, on the Kōshu-kaidō (cf. Murray's Handbook, 8th edit., p. 291). More surprising is the statement (p. 286) as to the "tangle of vines bearing small seedless grapes" on the lower slopes of the volcano Asama-yama. Surely these are merely the familiar bilberry bushes in which the neighbourhood abounds. The distances from the summit of Fuji-san both to the Lake of Yamanaka, and to the Otometōge are greatly exaggerated. The descriptions of scenery, mainly confined to the regions familiar to most tourists in Japan, indicate a genuine appreciation of natural beauty but are apt to become wearisome through excessive redundance.

The most interesting chapters are those describing visits to the artist craftsmen of Kyoto, etc. Of the pictures, those of Fuji-san from varied points of view and in all conditions; of the rapids of the Katsura (p. 237); and of "A Fisherman's Children" (p. 192) may be singled out as especially worthy of notice. It should be pointed out that the attractive feminine subjects depicted are almost all of a special class and do not represent the ordinary type of Japanese women. There is a full index, but no map whatever! W. W.

## AFRICA

**Siwa: The Oasis of Jupiter Ammon.— C. Dalrymple Belgrave.** With an introduction by **Sir Reginald Wingate.** London: John Lane. $7\frac{3}{4} \times 5\frac{1}{2}$. xxix. + 275 pp. 15*s. net.*

Some of our English officials in the service of the Egyptian and English Governments in Africa turn to good account their opportunities for studying the peoples and the countries in which they are employed. Captain Belgrave spent a year or so on the Libyan coast of Egypt, and was stationed at Siwa during 1920–21, in command of a section of the Frontier Districts Administration Camel Corps, and for some time as the District Officer of the oasis; and this book shows what profitable study can be made even in the restricted area of an oasis in the desert—a little town of some 8000 souls. The oasis of Siwa —quite apart from its association with the worship of Jupiter Ammon—has a special interest as being inhabited by a small settled urban population of the Libyan or Berber race who are quite distinct from the Bedouin Arabs by whom they are surrounded. It is a little island which was never entirely submerged by the Arab invasion, and though the inhabitants have accepted Islam they retain many of their old peculiar customs, such as a wedding ceremony reminiscent of marriage by capture.

Siwa has been visited and described by numerous travellers (see *Geo. Journ.*, 57, pp. 29–34, 312), of whom Mr. Belgrave mentions only some three or four, including a French Colonel Bertin, who in some unspecified year carried a collapsible boat there on camel-back, but was not allowed to use it on the lake. The others he dismisses with the erroneous statement (p. 101) that "most . . . were Germans." The visits of these travellers were generally

short and casual, and observations were in some cases carried on only under difficulties. Captain Belgrave spent nearly two years there (p. 134), and as he entered sympathetically into the life of the inhabitants he obtained their confidence and learnt much of their habits and customs. He gives some account of the history of Siwa, in part derived from an Arabic history of the oasis which appears to have been written in the fifteenth century and was read to him by an old sheikh; as to this, more precise information, with extracts, would have been welcome.

The town of Siwa is remarkable, the houses being built literally one on top of another, so that they tower up like a gigantic anthill, and, if we may trust the author's effective coloured sketches, seem like prototypes of American "sky-scrapers." The author declares that he is not an archæologist, and says scarcely anything of the temple ruins, though he gives a clear photograph of a bit of wall with inscribed scenes. But he indicates that there is ideal and almost virgin ground for excavating on these or in the rock tombs and emerald-mines. Mr. Belgrave's duties with the Camel Corps along the coast also enable him to describe the tract extending to Matruh and Sollum and the life of the Arabs of the desert, and he also gives a short account of the Senussi and their invasion of Western Egypt during the Great War. The book contains a poor sketch-map, and a loosely compiled "bibliography" with inaccurate titles and without dates of publication. F. A. E.

**Barotseland.**— **D. W. Stirke.** Introductory Chapter by **Sir Harry Johnston.** London: John Bale, Sons & Danielsson. 1922. Pp. 12 and 136. 45 *Illustrations and Sketch-map. Price* 21*s. net.*

Mr. Stirke, lately Native Commissioner, Northern Rhodesia, gives us in this work the result of investigations made during the eight years he spent among the Barotse. His record is almost entirely confined to the people—their origin, administration, industries, customs, legends, laws. The title of the book, 'Barotseland,' finds fuller justification in the introductory chapter (36 pages) contributed by Sir Harry Johnston, who, besides setting out his views on the origin of the Barotse and philological questions, deals broadly with physical features, flora, and fauna. Sir Harry and Mr. Stirke do not see eye to eye as to how the many small tribes who to-day make up the Barotse came to get that name—Mr. Stirke contends that the name is properly "Ba-rozi"—but there is agreement that the tribe which forms the true stock are rightly the A-luyi.

The impression given of the Barotse by Mr. Stirke is not very favourable, yet there are indications that they will play a part of importance in the development of South Central Africa. The value of the book lies mainly in the accurate description of the life and beliefs of a people in a stage of development now passing away. This picture of a primitive civilization is really illuminating. We are sorry that the author—obviously an admirer of the work carried on by the missionaries—does not deal more fully with the changes wrought by the introduction and spread of Christianity and education. He notes the decay of knowledge of family totems, the disuse of the elaborate salutation ceremony, and the general adoption of European clothing, and he gives the system of administration now in force—but there is no discussion of the main results of Christian teaching and Western civilization on the people, a thing much to be desired from an impartial authority. The book, too, lacks an index. F. R. C.

AMERICA

**Richard Schomburgk: Travels in British Guiana, 1840-1844.**— Translated and edited with geographical and general indices and route maps by **Walter E. Roth.** Vol. i. Size 11×7. Georgetown: Daily Chronicle Office. 1922.

Very cordially we welcome this translation of a work hitherto known only in the German—not so much because it adds anything new to the available knowledge of British Guiana, but because it has always seemed to us a book intrinsically worthy of a wider circle of readers. Published locally and not in a specially attractive form the present volume may possibly be slow in securing this.

The really important and more interesting events which came under the notice of Richard Schomburgk had already been made widely known by his more distinguished brother, Robert, the original explorer of the country, afterwards commissioned by the British Government to survey the boundary. A considerable portion of Robert Schomburgk's journals and reports was published in the Royal Geographical Society's Journals soon after their receipt by the Government (see vols. vi., vii., x., xiii.).

Richard Schomburgk went to Guiana for the first time when his brother returned there as Boundary Commissioner towards the end of 1840. He was attached as botanist to the expedition; and this *rôle* was also supported by his great work published at Leipzig in 1847 and dedicated to Frederick William IV., King of the Prussians. It may not be uninteresting to mention that the author later seems to have got into political trouble in Prussia and fled to South Australia, where in 1866 he became Director of the Botanic Gardens at Adelaide. He died in 1890.

Richard Schomburgk has found a capable and sympathetic translator in Mr. Walter E. Roth, who appears now to have established himself very much on the same plane as the Schomburgks and im Thurn as an observer of Indian manners and customs in British Guiana. A demy of Magdalen College, Oxford, a fully qualified medical man, he had done exceptionally good anthropological work in Queensland before the Secretary of State appointed him to the Pomeroon district in British Guiana. His studies of the basketwork of the Warraus and other Indians with their excellent illustrations (see *Journal of Anthropological Institute*, 1909–11) reveal Dr. Roth as an artist as well as a careful student.

Of Richard Schomburgk's three volumes only the first has so far been published in the translation: the second is to follow. The third volume is an inquiry into the fauna and flora of Guiana, with catalogues of both, which are now in part superseded by later investigations; this it is not proposed to translate.

The volume so far available for the English reader describes the departure from home, the stay in England, the arrival in British Guiana, the first survey to the mouth of the Orinoco, and the return to Essequibo; and then the voyage up the Essequibo and Rupununi on to the Savannas which border Brazil. This last voyage was coincident with the small military expedition to Pirara by which the British Government asserted their rights in the district, and the narrative here has abundant historical interest as well as amusing passages. Such incidents all have their lesson for us; without them the British Empire could not have held its own. The second volume will cover the more attractive part of the journeys, and contain that piece of exploration which Richard Schomburgk did alone.

The translation for the most part faithfully follows the original, but the old woodcuts are replaced by photographic reproductions, which are not always very good. A special feature which Dr. Roth has introduced is the sketch-maps at intervals to illustrate the journeys. As these are obviously indebted to some of Sir Robert Schomburgk's original maps they have a contemporaneous appearance, and they are a useful addition.

The translator prefixes an explanatory note which may be useful to many readers. Very interesting is his reference to the assistance given him by the superintendent of that Santa Rosa Mission which formed such a feature in the discussions of the boundary near Pomeroon. Why he finds it difficult to follow Schomburgk's route on recent maps is not apparent. Nor is the geographical index introduced at the suggestion of Mr. Clementi an addition of material value. Part of the interest in reading such travels is the personal identification of different forms of the same name.

This brief notice may well conclude with a reference to the note on p. 270. Dr. Roth suggests that our old friend "Kirahagh" (backwaters) has disappeared, and he hears them spoken of only as "Karsìa" or "Kuba." But to any one well acquainted with the physiology of speech these are clearly the familiar Kirahagh in a new guise. Once the writer was discussing with Sir Everard im Thurn the proper transliteration of a Macusi name, and im Thurn observed that he could never decide the sound: sometimes it was one thing, sometimes another. This is a frequent phenomenon in all philology.

C. A. H.

**The Recession of the Last Ice-Sheet in New England.**— **Ernst Antevs**, with a Preface and Contributions by **J. W. Goldthwait**. New York: American Geographical Society (Research Series, No. 11). 1922. Pp. xiii., 120, *with 19 Figures, 6 folding Plates, and a Map in colours.*

The work of Baron Gerard De Geer and his collaborateurs on the Late-Glacial clays of Sweden has opened up a new and promising line of attack on the problem of geological time. All up and down the scale of formations the geologist is confronted, here and there, by thick masses of strata which have clearly been accumulated under conditions reiterated in cycles of short phase. Whether the single cycle be tidal, seasonal, or of some longer period, if its time-value can be determined, the chronological span of such deposits is self-recorded, and can be read off by direct count. In the case of the Swedish lake-clays, De Geer showed that the repetition was annual, like the rings in a tree-trunk, and he was able to obtain a time-scale covering the last 13,500 years. For clays of this kind, he introduced the term *varve-clays*, the unit *varve* (Swedish, *varv*) being the sediments of a single annual cycle.

In 1920 De Geer extended his researches to glaciated districts in eastern parts of North America, and found here also a good development of the varve-clays, carrying the record of events which he thought might be correlated with events recorded in Sweden. Dr. E. Antevs, the author of the present memoir, with the advantage of his Swedish training, carried on the work in 1921 with excellent results, though he is unable to confirm the supposed correlation with the Swedish time-scale. He investigated varve-clays at over one hundred different localities, of which seventy-four were in the Connecticut valley, seventeen in that of the Merrimac, and ten in that of the Hudson. He interprets the results as yielding the record of events during about 4400 consecutive years during the retreat of the latest ice-sheet, but he has been unable as yet to link up this period with our present time.

Dr. Antevs's memoir has special value in being the fullest exposition of the

methods of varve-measurement and calculation available in English. In two short opening chapters he describes and illustrates the procedure and discusses the conditions of deposition of the sediments. Then follows a detailed account of the observations at all the sites, this occupying more than half of the book, illustrated by five folding plates on which the observations are plotted in combined curves and the method of correlation is demonstrated. In final chapters the results are summarized; the evidence interpreted; the variable rate of recession of the ice-border between all the sites measured in feet per annum; the climate conditions explained; and the presence of cyclic climatic periods indicated. In conclusion, the bearings of the new evidence on the results already attained by other methods of research is discussed, and are illustrated by a coloured map of the glacial phenomena of New England and New York which has been prepared by Prof. J. W. Goldthwait.

It is impossible in the space at our disposal to do justice to this work. Clearly, if the method continue to stand the test, it may yield results of great importance, not to the geologist only, but to the meteorologist also, and, as Prof. Goldthwait points out in his preface, to all "who are interested in the measurement of time, in prehistoric climate, and in the migrations of plants and animals." G. W. L.

**Journal of the Travels and Labours of Father Samuel Fritz.**— Translated from the Evora MS. and edited by the **Rev. Dr. George Edmundson.** London: printed for the Hakluyt Society. 1922. *With two Maps.*

Twenty years ago Dr. Edmundson had the good fortune to find a unique MS. of mission history in the library of the Archiepiscopal Palace at Evora. It was written in the Spanish language, and comprised 214 pages, embodying *inter alia* extensive portions of Samuel Fritz's journals and letters. The writer's identity is unknown; but it is clear that he was a brother missionary and was personally acquainted with Padre Samuel, and with several of his colleagues, and had himself travelled or resided in the region where they were working, among the higher tributaries of the Amazon river. The facts stated are in exact agreement with Don Antonio de Ulloa's outline of Fritz's career published in 1748. After consultation with the late Sir Clements Markham, it was resolved that this MS. was worthy of publication by the Hakluyt Society; and, the Council agreeing, Dr. Edmundson was entrusted with the work of translating and editing it.

Born in Bohemia in 1654, Samuel Fritz studied humane letters and philosophy, and was admitted, when nineteen years of age, into the Company of Jesus. He evinced brilliant mental qualities, so that the Superiors ear-marked him to fill the first positions in his own Province. But "showing a stronger inclination for the vocation to which God was calling him for the conversion of the heathen," with the approval of the Father General he proceeded to the Indies, and was attached to the Jesuits' College at Quito, whence he set forth in the year 1686 for the Marañon region. There he took charge of a mission to the Omaguas and other remote tribes, being the first missionary who went afield to preach the Faith in those parts; the few who preceded him having penetrated thither only for secular or political aims.

It is as an explorer, however, and especially a cartographer, rather than as an ecclesiastic, that Padre Samuel's name has come down to posterity. His remarkable map of the Marañón or Amazon river from its sources to the sea is what has gained him distinction in later times, more than his fanaticism and astonishing self-abnegation. Many of the data for its construction were procured at the daily peril of his life, in circumstances of extraordinary difficulty

and personal suffering during an arduous canoe journey down stream in the flood season to Gran Pará. There he was considerately treated, and nursed back to health, at the Jesuit College; but, a rumour gaining currency to the effect that Fritz had been acting as a spy on the encroachments by Portuguese agents in the Spanish sphere, the governor thought proper to detain him while the matter was referred to Lisbon. This procedure ended in his honourable release, but only after a delay of eighteen months. The padre was then sent back up the river with an escort, and busied himself in improving the map he had begun to draw, which he completed in the same year 1691. It was afterwards re-drawn on a reduced scale, with additions, and was engraved at Quito in 1707.

The translation in Dr. Edmundson's volume leaves much to be desired, for it betrays either a weak knowledge of idiomatic Spanish or an undiscriminating predilection for too literal a rendering, by which the meaning is apt to be clouded and the English is obviously marred. His version of the dedication and descriptive legend on Fritz's engraved map (of which a good reproduction is supplied at pp. 46–47), exhibits more than twenty departures from the text, many of them palpable errors of translation and transcription (names and figures), and others of a more debatable nature. The index, too, might have been fuller with advantage. B. G. C.

## MATHEMATICAL AND PHYSICAL GEOGRAPHY

**Die Oberflächenformen des Festlandes: ihre Untersuchung und Darstellung.—Alfred Hettner.** Leipzig und Berlin: B. G. Teubner. 1921. Pp. viii. and 250.

This volume is not in any sense a text-book, though it might with advantage be placed in the hands of an advanced student. It is a critical examination of modern views on the origin and development of land-forms, and still more a discussion of modern methods.

To a large extent it is a protest against the mode of thought characteristic of the Davis school, and there are comparatively few pages on which the name of Davis will not be found. The author does not deny the value of the work done by Davis or under his inspiration, but he holds that the method is unsound and likely to lead to error. From a speech made by Davis at the International Geographical Congress at Geneva he quotes: "The morphologist should in the first place go into a dark room and with closed eyes think, think, think; not till then should he go out to Nature." And this is the principle, he says, that dominates the work of the Davis school. It is the method of the old cosmogonists. They wrote many interesting books, but the interest is literary and historical, and the scientific value is small. If Davis had really followed his own advice it is probable that the value of his work would have been no greater. But he did not enter his darkened chamber to consider the development of rivers until he knew something about what rivers actually do in the way of erosion and deposition; and for this knowledge he was indebted to previous observation and mainly to the observations of those who looked before they thought.

Though the quotation is perhaps a caricature, it expresses forcibly enough the value that Davis attaches to the deductive method, and it entirely ignores the dangers. It is these dangers that Hettner wishes to emphasize. He points out with justice that where deductions can be tested quantitatively, as in the exact sciences, the value of the deductive method is unquestionable; but where quantitative comparisons between theory and observation are impossible the

method loses its force. It is at least exceptional for two different causes to produce effects which are identical both in kind and in degree; but there may be many causes which produce effects that are similar in kind though different in degree. This no doubt is the reason why discussion on such subjects as ice-erosion is so interminable. The deductions of the one party fail to convince the other, and ought to fail. It is not difficult to show that a certain series of processes may in time produce a certain form, but it is extremely difficult to prove that no other series can do so.

Hettner also objects to Davis's terminology as misleading; and in particular he disapproves of those terms which imply analogy with the life of a living being. An analogy, he says, is not an explanation. The form of a valley is not a question of age alone. It is a much more complex matter and requires a more complex explanation than the statement that it is mature or immature.

It must not be supposed, however, that Hettner's book is merely an attack upon the Davis school. It is much more than that. Perhaps it may best be summarized as a serious and thoughtful attempt to determine how much we really know of the origin of different land-forms, and how we should proceed in order to learn more. It is in fact a very useful and suggestive work, and the author's judgments are in general remarkably sane and well balanced.

P. L.

## GENERAL

**A Commercial Geography of the World.— O. J. R. Howarth, O.B.E., M.A.** Oxford: Clarendon Press. 1921. Pp. 235. 4*s. net.*

**Products of the Empire.— J. Clinton Cunningham, B.A.** Oxford: Clarendon Press. 1921. Pp. 300. 5*s.* 6*d. net.*

**Business Geography.— Ellsworth Huntington** and **Frank E. Williams.** London: Chapman & Hall, Ltd. 1922. Pp. 482. 13*s.* 6*d. net.*

In Mr. Howarth's little book the application of Professor Herbertson's regions to a study of economic products and commercial activities ensures a sound geographical basis for an outline study of commerce. Equally important is a knowledge of the various economic products; production, transport, and consumption so excellently set out in 'Products of the Empire.'

Business, on the other hand, is a complex operation, and the authors of a 'Business Geography' set out to investigate not only the usual geographical considerations of trade and commerce, but psychological, sociological, and similar problems. The book is valuable because of its bold suggestiveness and comprehension, but while there may be general agreement with the principles stated with regard to industrial fatigue, recreation, and so on, most English readers will feel that as the work is based largely on observations in the United States, the conclusions are somewhat too dogmatically stated. It is to be regretted that in so comprehensive a survey of the subject so little is said of social groups with a consciousness and psychology different from those of the individuals. This is particularly important where the effects of modern business is changing the whole social organization of backward peoples, a change which in turn is having a pronounced effect on business.

The book is a valuable contribution to the study of the modern world, but it should be read critically.

W. H. B.

# THE MONTHLY RECORD

## EUROPE

### Norden's Map of Sussex, 1595.

THE acquisition by the Society of Norden's map of Hampshire, in its extremely rare reissue by Peter Stent about 1660, was noted in the March number of the *Journal*. This has quickly been followed by the acquisition of another undescribed county map by the same author, this time of Sussex, and in the original issue dated 1595. This map seems to have been known hitherto only from the reduced versions included in Camden's 'Britannia' and Speed's 'Theatre of the Empire of Great Britain.' The present copy is in good preservation and is an excellent specimen of the engraving of the time, surpassing in this respect the copies of Kip and Hondius in the collections just mentioned. It is the work of Christopher Shwytzer, a Swiss settler in England whose hitherto known work includes a very rare plan of Durham engraved in the same year 1595 (copies of which are to be found in the British Museum and in the Cambridge University Library *), and the title-page to the English edition of the 'Divine Works' of Du Bartas published in 1605–1606. He is also mentioned as the author of some of the woodcuts in Speed's 'History of Great Britain' (see Colvin, 'Early Engraving . . . in England,' 1905, pp. 64, 165). In the Du Bartas title-page he is described as C. Swytzer, Figuri (evidently a misprint for Tiguri, *i.e.* Zurich). Some account of a Christopher Schweitzer, a wood engraver belonging to a well-known family of that city in the sixteenth century, is given in Brun's 'Schweizerisches Kunstler-Lexikon.' Work of this engraver is known from 1561–62, and it has been suggested that some of the woodcut illustrations in Münster's Cosmography of 1555, etc., signed with the initials C. S., may also be by him. This man can hardly have been the author of Norden's map of Sussex now brought to light, but it seems probable that the two craftsmen were father and son.

### The Study of English Place-names.

It is only in quite recent years that the great value and interest of a study of place-names, when carried out on a thoroughly sound system, has been understood even by writers on the subject. Thanks largely to the pioneer work of the late Prof. Skeat, a wide interest has now been aroused, and in the competent hands into which the 'Survey of English Place-names' has fallen, results of great value may before long be expected. The Director of the Survey, Prof. Allen Mawer, in delivering the Robert Spence Watson Memorial Lecture at Newcastle-on-Tyne in September last, gave an illuminating account of the way in which the scientific study of place-names may throw light on historical and ethnographical questions. The lecture has since been printed by the Liverpool University Press, and may be had at the small charge of one shilling, any author's profits that may arise from the sale being given to the funds of the Survey. The fundamental rule by which modern investigators are guided is that it is impossible to place any satisfactory interpretation upon the history of a name until we have traced it back as far as the records will allow, the failure to do this having led in the past to all sorts of incorrect etymologies. Prof. Mawer deals in turn with the many ways in which the study can be of value. It may help to identify sites of early historical events, such as battles; it may tell us of otherwise unknown movements from one district to another; lost

* The existence of the Cambridge copy has been kindly brought to our notice by Mr. A. M. Hind of the British Museum.

tribes may be recovered, or new light thrown on the part played in our history by foreign peoples like the Frisians and Flemings; hoary legends like that of the founding of Colchester by King Cole may be refuted. On the constructive side it will prove most valuable in supplementing the documentary evidence for our early history and also in explaining much that is obscure in that evidence. Much light can be thrown on such matters as the survival of pre-Celtic or Celtic elements in the midst of the newer population, or the influence of Scandinavian settlers from Ireland familiar with Gaelic methods of nomenclature. Particularly interesting is the evidence supplied as to the racial divisions and spheres of influence of our Teutonic conquerors and the manner of their settlement. It has been shown by Dr. Grundy that suffixes like *ton*, *worth*, *wich*, *wick*, and *ham*, commonly rendered vaguely as enclosure, dwelling, or farm, had each of them once a distinctive meaning. Thus in Saxon charters for Wiltshire, out of seventy-three occurrences of *worth* with an attribute prefixed, in no fewer than fifty-four the attributes are personal; whereas out of forty-three *wicks* accompanied by an attribute only two attributes are personal. The conclusion is that the *worth* was some kind of personal possession, while the *wick* denoted something belonging to the community—perhaps a dairy-farm. Similarly Prof. Mawer himself has shown that the chief use of *stow* in early English names was to denote land dedicated to the service of the Church or some saint. A study of the distribution of such suffixes over the country also yields striking results, and it is of great interest to discover what suffixes were in living use at particular periods, and the times at which names or types of names made their first appearance. Many illustrations of our early social system are supplied —*e.g.* the character of the meeting-places of the *moots* or *things* of the several hundreds or wapentakes; the ownership of land by women; the part played by the freeman (*cniht* or *ceorl*) in English life; the survivals of heathen beliefs, and the like. Mediæval means of communication are also most happily illustrated. Enough has been said to show that the study is a fascinating one, and though at present only in its early stages, may be confidently expected to yield rich results as the data are accumulated by the united labours of many workers.

**Count Ferraris's Great Map of Belgium, 1777.**

By one of the clauses of the recent treaty of St. Germain Austria agreed to restore to Belgium, among other works of national interest, the original MS. sheets of the great map of Belgium, made in the latter part of the eighteenth century by Count Joseph de Ferraris, together with a large part of the documents relating to it. An interesting sketch of the history of the great undertaking has been given by M. Albert Tiberghien, Deputy Keeper of the Royal Library at Brussels, in the *Bulletin Officiel* of the Touring Club de Belgique, 15 November 1922. The map was one of the most remarkable achievements of its time, and even Cassini, author of the great map of France (not completed until after that of Ferraris), freely expressed his admiration for the work, and declared that the Belgian sheets surpassed anything that had previously appeared for their exactitude and their representation of the country. Ferraris was born in Lorraine in 1726, and was thus a countryman of Prince Charles, appointed Governor-General of the Austrian Netherlands by his sister-in-law, the Empress Maria Theresa. Ferraris became Director-General of Artillery in the Netherlands in 1767, and soon identified himself with the social life of the country, his ties with which were strengthened by his marriage with a member of one of the old patrician families. The idea of a large-scale map of the Austrian Netherlands came from the Empress herself, but several proposals had been put aside as impracticable, when Ferraris submitted a scheme which

was accepted. He proposed, in the first instance, to extend to the Austrian provinces (but a part of the modern Belgium) the map of France then in course of execution by Cassini—the first topographical map of similar extent ever undertaken on the basis of precise scientific methods. But the Belgian map was eventually extended over the territories (some mere enclaves in the rest) not owning allegiance to the Empress. No topographical material of serious value was then in existence, and it was necessary to execute a detailed survey of the whole on the scale of 1/11,520; but thanks to the energetic support of his coadjutors, the task, begun in 1770, was completed by Ferraris in 1774. The surveys filled 275 sheets, whilst notes and observations of all kinds, of the highest interest for the local history, toponymy, and topography, were brought together in twelve MS. volumes. These, together with the original survey sheets, were taken to Vienna on the invasion of Belgium by the French republican armies, but were never published. The engraving of the map on the reduced scale of 1/86,400 (the scale of Cassini's map of France) was begun in 1773 and completed in 1777. It occupied 25 sheets, engraved in great part by one L. A. Dupuis, whilst the artistic embellishment was the work of the well-known French engraver Tardieu and three other artists. The map at once took rank as the standard authority on Belgian topography, a position which it maintained for more than half a century, and copies are even now sought after for their historical interest. The Society's collections include three complete sets of the 25 sheets. Of the original MS. map, which is on a scale larger than that of any published map of Belgium, three sets were made, one of which was given by the daughter of Ferraris to the King of the Netherlands, and so became lost to Belgium, as were also the copper-plates of the engraved map which followed the same road, after having been taken to Paris during the revolutionary wars. It is one of the other two sets, together with the accompanying memoirs, which now at last returns to its natural home in Belgium.

## ASIA

**Map of a Part of the Amadia District, Iraq.**

Colonel K. Cornwallis, Adviser to the Ministry of the Interior, Iraq, has presented to the Society a copy of a map of the north-east portion of the Amadia district, which lies to the south-east of Lake Van. The map is drawn from compass surveys of Mr. R. F. Jardine, resident divisional adviser of the Iraq Government, during his travels as political officer from 1919 to 1922. By means of compass bearings, adjusted to the points previously fixed by the survey party to the west of the Tab, he was able to make a sketch-map which, although only claimed to be approximately correct, adds considerably to the knowledge of the topography of the district. Previous to Mr. Jardine's work the best map was that compiled by Colonel F. R. Maunsell, R.A., and first published by the War Office, on the scale of 1/250,000, in 1901–2. The area covered by Mr. Jardine's work is included in sheets Nos. 26 and 27 of this map, and a comparison will show that considerable alterations and corrections have been made. No heights are given, but relief is shown by approximate form-lines in brown.

**Important Discovery of Fossil Remains in the Gobi Desert.**

Mr. A. C. Andrews, whose sporting adventures in Mongolia were referred to in the Society's *Journal* of April 1922, p. 301, recently gave an account of a third journey which he made at the head of a scientific mission financed by Americans and assisted by the American Asiatic Society. It had been predicted by Prof. Osborn, the distinguished President of the American Museum

of Natural History, that the great plateau of Central Asia would prove to be the birthplace of much of the animal-life of Europe and America, and the object of the mission, as stated in the *Peking and Tientsin Times* of March 7, was to investigate the Gobi Desert with a view to the discovery of fossil remains, which it was thought would be likely to throw light on the "stem" or ancestral forms of animal-life not present in either Europe or America. According to the newspaper report the expedition was immediately successful in the discovery of a huge field of fossil beds, though no fossils had ever been found there previously with the exception of a fragment of a rhinoceros jaw, and it became evident that the theory upon which it had come into the field was true. Remains were found of dinosaurs, rhinoceros, horse, tapir, elephant, and other animals common to Europe and America. But the most interesting find probably was that of the skull and parts of the skeleton of the Baluchitherium and of an early ancestor of the great horned Dinosaurs. In addition to other work much of Mongolia had been mapped, existing maps found to be untrustworthy, and the fauna of the country studied, while the hunting of animals had been pursued with the concomitants of motor cars, cinematograph, etc.

The expedition was to leave again for Mongolia in April, and to continue the researches, which have already, in the words of Prof. Osborn, "opened out a new chapter in the history of the world."

## AFRICA

### Captain Angus Buchanan in the Sahara.

Captain A. Buchanan, whose previous explorations in the Saharan mountain district of Aïr were described in his book reviewed last year in the *Journal* (vol. 59, p. 467), and who started again for further work in the same region in company with Mr. Francis Rodd, was lately reported to be on his way home by the northern route across the Sahara. The expedition made its way through Nigeria to Aïr, whence it hoped to push north-east to Tibesti, but this proved impossible. Mr. Rodd returned home from Aïr (the exploration of which he is to describe before the Society on June 4). The French authorities having refused permission to cross the Sahara to Algeria, Captain Buchanan started to return by way of Timbuktu and Senegal, but after proceeding some 300 miles, was overtaken by a messenger giving the required permission to take the northern route. During April his arrival at Tamanrasset, in the desert between Aïr and Insalah, was announced, and it is understood that his arrival in England may shortly be expected.

## AUSTRALASIA AND PACIFIC ISLANDS

### Mr. James Macrae's Journal in the Sandwich Islands, 1825.

When, in 1824, Lord Byron was sent by the British Government to convey to the Sandwich Islands the remains of King Kamehameha II. and his queen, who had died in London whilst on a visit to King George IV., the Horticultural Society of London obtained permission to send in the *Blonde*, Byron's ship, a fine collection of plants considered suitable for the climate of "Owyhee," under the charge of James Macrae, a young Scotsman, trained as a plant collector and horticulturist. This man, who was a careful observer as well as collector of plants and objects of natural history, kept a diary which with his herbarium was handed over to the Horticultural Society on his return, and has remained in the keeping of that body (now the Royal Horticultural Society) ever since, but until last year no part had been published. As the only published

account of the *Blonde's* voyage is the far from satisfactory compilation by Mrs. Maria Graham published in 1826 (based chiefly on the diary kept by the Chaplain, Mr. Bloxom), it seemed to Mr. W. F. Wilson of Honolulu that it would be worth while to print at least the part of Macrae's diary concerned with the story of the Hawaiian islands, and this he obtained the permission of the Council of the Royal Horticultural Society to do. The result is an illustrated brochure of 75 pages published last year at Honolulu under the title 'With Lord Byron at the Sandwich Islands in 1825: Being Extracts from the MS. Diary of James Macrae, Scottish Botanist.' The editor, who has added useful explanatory notes throughout, remarks with justice that "in Macrae's Journal will be found some curious glimpses of men and manners at the close of the first quarter of the nineteenth century," and the accounts of his ascents of Mauna Kea and the Kilauea volcano are specially interesting. Some sidelights are thrown on the means by which, with the help of the Englishmen Young and Davis, King Kamehameha "the Great" established his sovereignty over the island of Oahu. Young was still living at the time though already aged eighty-three (he lived still another ten years, dying in 1835), and Macrae saw a good deal of him, as well as of Alexander Adams, the third of the British sailors who had made their home in the islands and were the trusted councillors of Kamehameha the First. Adams was much younger, but at his death in 1871 had reached the age of ninety-one. Macrae was not the first to reach the summit of Mauna Kea, which had already been ascended (in 1823) by the American missionary, the Rev. Joseph Goodrich, and soon afterwards by Dr. Blatchley and Mr. Ruggles of the same mission.* Mr. Goodrich guided Macrae on his ascent, but suffered severely from mountain sickness, and did not reach the summit on this occasion. Others of the party were Messrs. Talbot and Wilson, respectively Fourth Lieutenant and Purser of the *Blonde*; but these, like the natives, were overcome by the cold and were left behind, Macrae, who also suffered from the rarity of the air, reaching the top with a boy only. He considered the height of the mountain (the highest in Hawaii) to be 18,000 feet in place of the actual 13,825 feet. The ascent of Kilauea was made in company with Messrs. Talbot and Wilson, with a blacksmith resident on the island as guide and five native porters, who descended into the crater with the white men, the heat from the burning "pillars" with the suffocating sulphurous smoke making the feat a somewhat dangerous one. Interesting observations on the vegetation, natural history, and manners of the natives, are made throughout.

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## CORRESPONDENCE

### Captain England and the "Nimrod."

ON page 122 of my 'Life of Sir Ernest Shackleton' I referred to the difficulties which accompanied the landing at Cape Royds in 1908. I was unable to get into touch with Captain Rupert England, who commanded the *Nimrod* and was second in command of the expedition, until after the publication of the book. He has since been kind enough to furnish me with much additional information which enables me to view the circumstances from all sides, and to recognize that I have unwittingly done him less than justice in the passage

* Mauna Loa had already been ascended by Macrae's compatriot Archibald Menzies, surgeon and naturalist.

referred to. For this I am sorry, and I have gladly agreed to rewrite the page so as to convey a true impression in any subsequent edition.

Meanwhile I hope you will allow me to place on record in the *Geographical Journal* that I feel sure that Captain England was actuated solely by a high sense of duty to the expedition, and that in discussing the division of the slender coal supply between the land-party and the ship he took the needs of both into consideration. Also, as the stores provided for the contingency of the ship having to winter in the Antarctic had been left behind in New Zealand to make room for vital equipment for the landing party, it was necessary for the sake of the crew to run no risk of being beset. The change of base made it equally essential to the safety of the land party to communicate at once with home, as a relief ship would otherwise be sent to any part of the Antarctic rather than McMurdo Sound. In these circumstances extreme caution was of the first importance in handling a small ship, with the unseaworthy trim brought about by emptying the holds, amongst the ice of an uncharted sea in terrible weather. The whole voyage, outward while dangerously overloaded, and homeward while as dangerously light, was one of extraordinary difficulty, and as a feat of seamanship reflects the highest credit on Captain England. I should be sorry indeed if any one should derive any other impression from the brief references in my book.

HUGH ROBERT MILL.

Hill Crest, Dormans Park, Surrey,
18 May 1923.

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## MEETINGS: ROYAL GEOGRAPHICAL SOCIETY: SESSION 1922–1923

**Eleventh Evening Meeting, 23 April 1923.**—The President in the Chair.

ELECTIONS.—J. E. Bellows; John Harwood Clarke; Major R. M. L. Dutton, M.C., O.B.E.; Rev. Ernest Walter Gibbons; Alfred Gale Johnson, F.I.S.A.; Rev. Thomas A. Lambie, M.D.; George William Pearse; James Shreeves, F.C.I.S.; Rev. John Herbert Chisam Smith; G. H. B. Ward; Edwin Williams, B.S.C., A.I.C.

Paper: Inner Mongolia. L. H. Dudley Buxton.

**Twelfth Evening Meeting, 7 May 1923.**—The President in the Chair.

ELECTIONS.—George Menteth Boughey, O.B.E.; Edgar Lionel Browning, M.C.; Lady Lilian Mabel Alice Richmond Brown; Arthur Delman Combe; Leonard Darlot, J.P.; L. E. Haslam Fellows; Cyril Ernest Fiske, B.A.; Miss Edith Annie Frizell, B.A.; Miss Joan Haggard; Capt. J. R. Wilson-Happenden; Mrs. Guida Howeson; William Morris-Jones; Montague Arthur Lush; The Very Rev. Edward Clarence Paget, D.D. (Dean of Calgary); Samuel Wesley Rollings, B.SC.; Thomas William Sowerbutts; Robert J. Thompson.

Paper: The Tibetan Border: Yangtse to Irrawaddy. F. Kingdon Ward.

**Seventh Afternoon Meeting, 14 May 1923.**—The President in the Chair.

Paper: The Banda Arc: its Structure and Geographical Relations. Prof. J. W. Gregory.

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